ATTORNEY-CLIENT PRIVILEGE/FOIA-EXEMPT

United States Environmental Protection Agency

INVESTIGATIVE ACTIVITY REPORT

Case Name:
AK STEEL

Reporting Office:
CHICAGO

Subject of Report:
INTERVIEW OF [redacted] AT HIS RESIDENCE OF [redacted]
Date of Interview: November 11, 2004

Copies to:
Robert Guenther, Associate Regional Counsel, Region 5
Robert Darnell, Trial Attorney, Environmental and Natural Resources Division, U.S. Department of Justice

Related Files:

Reporting Official and Date:

11/15/04
Reginald Arkell, CI

Approving Official and Date:

<u>INTRODUCTION</u>

Pursuant to a request by the U.S. EPA, Office of Regional Counsel, Region 5, and the Environmental and Natural Resources Division of the U.S. Department of Justice, CI Reginald Arkell previously researched records of the Miami Conservancy District (MCD) in Dayton, Ohio, pertaining to Dick's Creek. Copies of records were obtained concerning excavation and dredging work performed at the creek in the vicinity of the AK Steel facility in Middletown, Ohio, during the mid-1960s through the mid-1980s. The research is documented in memorandums dated February 4, 2004, and July 1, 2004. The purpose of the research was to help identify the movement of potential PCB-laden material alleged to have originated from AK Steel so that any contamination can be remediated. A resident of Middletown by the name of [redacted] identified several individuals including [redacted] who are longtime residents of Middletown that may have relevant knowledge. On the above date, CI Arkell met with [redacted] and [redacted] at the above location. [redacted] granddaughter, [redacted], was present during the interview. A 22"x 32" map depicting Dick's Creek from Sta. 0+00 to Sta. 160+00, dated February 10, 1966, that had been copied from MCD records was provided for viewing. The information below was obtained from [redacted].

DETAILS

- He is 79 years old and has lived at his current residence since about 1962. His wife is deceased. [redacted] said she and her mother, [redacted] [redacted], moved in with [redacted] to help take care of him. Their residence is located on property at the [redacted] The property is also [redacted] He said the property consists of two parcels with frontage of about [redacted] He worked for many years as a truck driver before retiring at the age of 65. He has never been employed by AK Steel but frequently hauled materials to and from their plant site near his residence. See Figures 1, 2 and 3 for pictures of [redacted]

- He only recalls one occasion when work was performed to widen and/or deepen Dick's Creek in the vicinity of his residence. He could not estimate the date when this work was performed. He initially said that he had been living at his current residence for about 15-20 years before the work was done. However, he later acknowledged it was very possible that the work could have taken place in the 1960s. He recalled someone stopping by his house and asking if he had a need for dredged/excavated material from Dick's Creek for use as fill in his yard. He did not know who this person was or the entity the individual represented. He accepted the material.

- He has always experienced some flooding from Dick's Creek in his back yard. His property slopes down from [redacted] as it approaches Dick's Creek. He was glad to have the material so that his property could be leveled off to some extent. He vaguely recalls that the excavation work at Dick's Creek resulted in the taking of some of his property. He was unsure as to how much was taken or if a deed was executed to document the property transfer. The distance of his property [redacted] to Dick's Creek had been [redacted] was now about [redacted] as a result. He still experiences flooding at the far back end of his rear yard but not to the same extent as before the work was done.

- The material taken from Dick's Creek was moved by some type of equipment with a scraper that transported and/or dragged the fill before spreading it onto his property. He did not recall it being loaded into dump trucks of any kind. He did not know the company that performed this work. He could not estimate the volume or depth of the material that was placed on his land. The material was spread from about the entire eastern side of his property beginning at some point in his front yard and extending south to the back yard. The material placed behind his home extended from the back of the house to a point about one-half or more the length of his back yard to Dick's Creek. He pointed out a visible ridge extending from east to west in about the middle of his back yard which was where the filling stopped. He was vague as to how much of this he actually saw being done as he was working as a truck driver during the day at the time. The back portion of his property has some growth of trees and brush in a northern portion but mostly consists of a fallow field extending back to the creek. There are several hundred lawn mowers on his property.

- He identified two additional areas near his home where dredged/excavated material from Dick's Creek was transported during about the same time. The first property is currently surrounded by a chain link fence located on the east side of Yankee Road adjacent to and north of Dick's Creek. This had been the location of the Glenn Cartage Company where he had worked. See Figures 4 and 5 for photographs of this property. The second property is land where a welding shop is located at the southeast corner of the intersection of Dick's Creek and Yankee Road (Orman's Welding Center). See Figures 3, 4, 6 and 7 for photographs of this property. Again, he was vague as to how much of the work he actually saw. However, he was adamant that the height of these areas was raised by the placement of fill from Dick's Creek. He could not estimate the volume or depth of the material that was placed on these properties.

- He refused to sign a written statement as to the information he provided. He also would not consent to any photographs taken of his property from his land. He could not provide a reason why other than he did not perceive that any potential

Non-responsive

[redacted]

F

FIGURE 4
FMR GLEN CARTAGE COMPANY PROPERTY

Fig
Yar

FIGURE 5
FMR GLEN CARTAGE CO PROPERTY FROM ORAHN'S PARKING LOT.

Fig. :
the F

FIGURE 6
ORAHN'S WELDING AS SEEN FROM YOUNGE ROAD.

Fig. 7 - Orman Welding Center Property looking Southeast from Yankee

"Rojko, Cathy (ENRD)"
<CRojko@enrd.usdoj.gov>
12/13/2004 12:02 PM

To

Subject AK Steel Ohio -- tomorrow's call at 11 a.m. Eastern/10 a.m. Centr al time

PRIVILEGED AND CONFIDENTIAL
ATTORNEY-CLIENT PRIVILEGED
ATTORNEY WORK PRODUCT

For tomorrow's call at 11 a.m. Eastern time/10 a.m. Central time, see below for draft agenda:

-- Settlement Update (Steve, Rob, et al.)

-- floodplain work plan from AK Steel

-- Reach 2 sampling (Mike M.)

-- upcoming meeting with AK Steel

-- penalty issues (expect penalty offer from AK Steel at meeting this week/discuss potential reaction) (Steve, Rob, et al.)

-- consent decree draft (Rob and Cathy)
-- need to prepare scope of work attachment (who will do this?)
-- SEP attachment (revisions will probably have to wait until get more info from AK Steel)

-- Anything Else?

The call in number is [redacted] pass code [redacted] Let me know if you are unable to attend.

DOJ -- all conference rooms are taken. Let's meet in Steve's office.

Cathy.

7:30 pm +

3:35 PM

PRIVILEGED AND CONFIDENTIAL
ATTORNEY-CLIENT PRIVILEGED
ATTORNEY WORK PRODUCT
DRAFT 12/09/04

Dredge Spoil Disposal Areas

Dredging and/or channelization has taken place in 1967, 1975, 1976 and 1984 from point 400 feet west/downstream of Yankee Rd bridge to upstream/east of Yankee Rd bridge to Sta 150+00 (intersection of North Branch of DC and main DC). (We know that Armco/AK had at least 57 PCB transformers in 1977. Many of these had probably been there for 20 to 30 years prior. Beginning in 1983, Armco/AK began disposing of PCBs transformers, which was completed around 1999. We do not know the first use date for PCBs hydraulic oil at the Middletown works. We do know that Armco purchased 990,000 pounds of Monsanto-brand hydraulic oil between 1970 and 1972. I believe PCB hydraulic oil use began in the mid 1950's.)

1967
The 1967 dredging/channelization between Sta 0+00 to Sta 50+00 straightened the creek by pushing the sediments onto the existing creek-banks and/or floodplain areas. This dredging also isolated two large meanders located at Sta 19+00---Sta 25+00 and Sta 38+00---Sta 48+00. An estimated 100,000 cubic yards of creek sediments east of Sta 50 to Sta 150 were also removed to onsite Armco fill areas (see MCC 9/1/04 revised Contract Map 142). <u>As part of Corrective Action (CA), we should require AK to sample several of these open onsite fill areas to determine if PCBs are present.</u> We may want to require 25 to 30 of "discretionary samples" that are chosen by EPA for this purpose and sampled/tested by AK.

1975 and 1976
The extent of dredging work done in 1975 and 1976 and the location of dredge spoil disposal areas are unknown at this time.

1984
In 1984, several areas in DC were dredged from Yankee Rd Sta 0+00 to 58+100. The 1984 project removed 22,180 cubic yards of dredge spoils to nearby locations. MCD records on the 1984 dredging indicate that show dredge spoils being placed in 6 disposal areas (listed below) near residential and/or floodplain areas. We have 10 Daily Construction Reports (DCRs) that give us some information as to the disposition of dredge material in 1984. Note that in the first Daily Construction Report (**DCR1**) dated 7/25/84 on the "Location of Spoil Area" entry states the following: "*Kelchner has contacted several landowners along Oxford State Road about placing spoil on slopes and high portions of properties along Oxford State. He hopes to spoil most of the material with pans and use the haul roads as little as possible.*"

Reggie Arkell's interview/memo with [redacted] supports the above as he indicated that "*the material taken from Dicks Creek was moved by some type of equipment with a scrapper that transported and/or dragged the fill before spreading it onto his property. He did not recall it being loaded into dump trucks of any kind.*" Also, the 11/16/04 interview/memo with MCD's Rinehart states that "*project work in 1984 was focused on excavating the material from the banks of the waterway....the majority of material removed was deposited in areas farther away from the creek.....some type of equipment with a scrapper was used to remove most of the material.*" MCD's Rinehart also identified the [redacted] property as dredge material disposal site. See Figure 2 and green property in the Rinehart memo. As part of CA, I think the whole [redacted] lot needs to be sampled for PCBs.

[redacted] also indicated that the Glenn Cartage Company property received Dicks Creek material. See Figure 2 and the violet property in the Rinehart memo. Arcadis Figure 2 provided by AK shows the two meanders between Yankee Rd and the NY RR bridge. Dicks Creek dredge material from the larger north-side meander was probably spread onto this property in the same way as the nearby [redacted] property. Arcadis Figure 2 shows 15 floodplain sampling locations between Yankee Rd and the NYRR bridge, including the proposed deep sampling location at the top of the north-side meander. The northside meander may actually be part of the Glenn Cartage Company property. As part of CA, I think the entire Glenn Cartage property needs to be sampled for PCBs. I am concerned about the several properties located between the [redacted] and Glenn Cartage properties. The Acardis Figure 2 ariel photo-map is dated 2004 and appears to show trees and open areas with no buildings. Unless this area is a high spot, you would think that fill material would have been spread across this area also. Under CA, some additional sampling should be done in the back-half of these properties.

The remaining DCRs, with dates, Limits of Earthwork, Location of Spoil Area and Construction Activity entry information and disposal amounts are listed below. Note that the right bank is the north-side of Dicks Creek and left bank is the south-side if Dicks Creek. See MCC 9/1/04 revised Contract Map 142)

DCR2 dated 8/6/84 Right bank Sta 14+00 to Sta 18+00 (area midway between RR bridge and Old channel Spoil Area) Location of Spoil Area entry states "Equipment parked at Oxford State Road with rear of lot used as disposal site."

DCR3 dated 8/14/84 Right bank Sta 32+00 to Sta 36+00 (near/upstream of Outfall 002) Location of Spoil Area entry states "Equipment parked at Oxford State Road with rear of lot used as disposal site." Construction Activities entry states that "widend road on Levey & put 4 ' fill over Standard Oil & C.G.& E Lines..Removed one tree on Levey Station 36 +00" (Levey is probably levee.) The Standard Oil and C.G.&E pipelines mentioned above crosses Dicks Creek (DC) at the NY RR bridge and runs along Oxford State Rd. Unclear where the 4 feet of fill would have been placed, but it could be at Sta 36 ,along Oxford State Rd, north of Outfall 002. See Arcadis Figure 4 map/photo.

DCR4 dated 8/15/84 Right bank Sta 36+00 to Sta 39+46 (near/upstream of Outfall 002) Location of Spoil Area entry states "Equipment parked at Oxford State Road with rear of lot used as disposal site." Construction Activities entry states "10:00 to 3:30 Loaded trucks for Armco"

DCR5 dated 8/16/84 Right bank Sta 38 +00 to Sta 44 +00 (near/upstream of Outfall 002) Location of Spoil Area entry states "Equipment parked at Oxford State Road with rear of lot used as disposal site." Construction Activities entry states "Loading and hauling dirt between Sta 38+00 -41+64.23 Loading Trucks for Armco & 2 Euclid Pans hauling in Burridge Machine Shop Lot...Kelchner started disposal area in lot behind Burridge Machine Shop.

DCR6a dated 8/21/84 Right Bank Sta 56+00 to Sta 58+00 (near/upstream of slag haul road) Location of Spoil Area entry states "Equipment parked at Burridge Machine on Oxford State Road, rear lot used as disposal area".

<u>I think the disposal area for DCRs 3 thru 6a is the rear lot of the old Burridge Machine Shop property and/or the old Armco lot located north/above the Old Channel Spoil areas and south of Oxford State Rd.. See Figure 2 and yellow property in the Rinehart memo. CA sampling should focus of the rear half of the old Burridge Machine Shop property but some samples should be taken in the front portions as the fill dirt may have moved around over the years. CA sampling should also sample the old Armco lot located north/above the Old Channel Spoil areas and south of Oxford State Rd..</u>

DCR6b dated 8/21/84 Left Bank Sta 4+00 to Sta 6+00 (near/upstream Yankee Rd bridge) Location of Spoil Area entry states "Disposal site Middletown Welding Co. Lot. Disposal for left bank material between Yankee & RR bridge". <u>This is the Orman Welding property and is identified in Figure 2 as the pink property. Mike Mikulka says that a photo at Orman's shows the 1984 disturbed/regraded area adjacent to Dicks Creek. As I understand our current sampling agreements with AK, this areas should be addressed via our hot spot and floodplain sampling.</u>

DCR7 dated 8/28/84 Left bank Sta 54+00 to Sta 58+00 (near/upstream of slag haul road) "Removing dirt at creek side and stock piling. Did not haul any today"

DCR8 date ?? Left Bank Sta 36+00 to Sta 38+00 and Sta 52+00 to Sta 54+00 Location of Spoil Area entry states "Disposal area on Armco lot left side of the stream." Construction Activities entry states "2 Euclid pans hauling dirt ...61 loads Armco lot... site visit A.M. Rinehart." <u>This may be the AK Steel General Slag Dumping Area identified by Rinehart and shown in Figure 2. I think we have some floodplain samples on the south side of the creek near this area.?? They may have used the dredge material to cap the old slag landfill area so some CA sampling in the 0- 1' and 1-2' foot range may be warranted. Suggest we try and get 10 to 20 discretionary samples for this area.</u>

DCR 9 dated 9/8/84 Left Bank Sta 24+00 to Sta 28 +00 (south-side opposite the big meander) Location of Spoil Area entry states "Disposal area Oxford State Rd and Ottawa St." Construction Activities entry states "Loaded and hauled 97 loads on 2 Euclid Pans." <u>This area was not</u>

specifically identified in the [redacted] or Rinehart memos. It may be old Armco lot located north/above the Old Channel Spoil areas and south of Oxford State Rd. I could also be AK/Armco property located at the intersection of Oxford State Rd (northside) and Ottawa St. (westside) near the old Coke Oven Condensate Tanks. CA sampling should be done in this both areas.

DCR10 dated 9/13/84 Left bank Sta 18+00 to Sta 24 +00 (south-side opposite the big meander) Location of Spoil Area entry states "Disposal area on right bank at station 14+00 on private lot Cecil Osburn Oxford State Rd". This one is weird in that left/south bank material is being reported disposed of on the right/northside of Dicks Creek?? Sta 14 +00 and Oxford State Rd intersection would be one/two of the properties shown in Figure 2 that is about half between the Old Channel Spoil Area and the NY RR bridge?? Properties 8, 9. and/or 10 as shown in Figure 2. Arcardis Figure 3 photo-map dated 2004 shows area to have some trees but mostly open area

We need to remember that MCD memo dated 8/27/84 describes the proposed installation of 693 feet of "beach drains" mostly on the right bank or north side of Dick's Creek between Stations 8 to 45. The drains are described as 3 to 3.5 feet wide and 12 to 18 inches deep and fill with +4" slag even with the beach grade. It is unclear to me if these drains are perpendicular or parallel to Dicks Creek. Do we want to ask AK for more information on this?? Should they sample several of the beach drains as part of CA to see if they are a PCB problem??

Lastly, the MCD memo (page 2, item 4) also mentions a buried 30" metal culvert near 19+65 that has no outlet to the creek . This area is located in the "old channel spoil areas" on MCD Contract 142 Map. The culvert could have accumulated PCBs over the years and/or PCBs may have discharged to the creek via the culvert. I think we need to tell AK about this, before they begin any remediation of this area of Reach 1.

Based on the above, there are ten suspected areas there 1984 Dicks Creek dredge spoils were placed. Beginning at Yankee Rd Bridge and moving eastward the suspected areas are:

- Glenn Cartage property (violet on Figure 2) (north-side DC);
- Back-half of properties between Glenn Cartage and [redacted] properties (north-side DC);
- [redacted] property (green on Figure 2) (north-side DC);
- Middletown/Ormans Welding (pink of Figure 2) (south-side DC);
- Back-half of properties located between Sta 12 to Sta 18 (Osburn lot north-side DC);
- Old Armco lot/property north of big meander between Sta 19 to Sta 25 (north-side DC);
- AK/Armco property located at the intersection of Oxford State Rd (northside) and Ottawa St. (westside) near the old Coke Oven Condensate Tanks;
- Pipeline fill-Sta 36, along Oxford State Rd, north of Outfall 002. (northside DC);
- Burridge Machine Property (yellow on Figure 2) (northside DC); and
- AK Steel General Slag Dumping Area.

Areas of concern would be the beach drains between Sta 8 to Sta 45 and buried culvert at Sta 19+65.

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United States Environmental Protection Agency

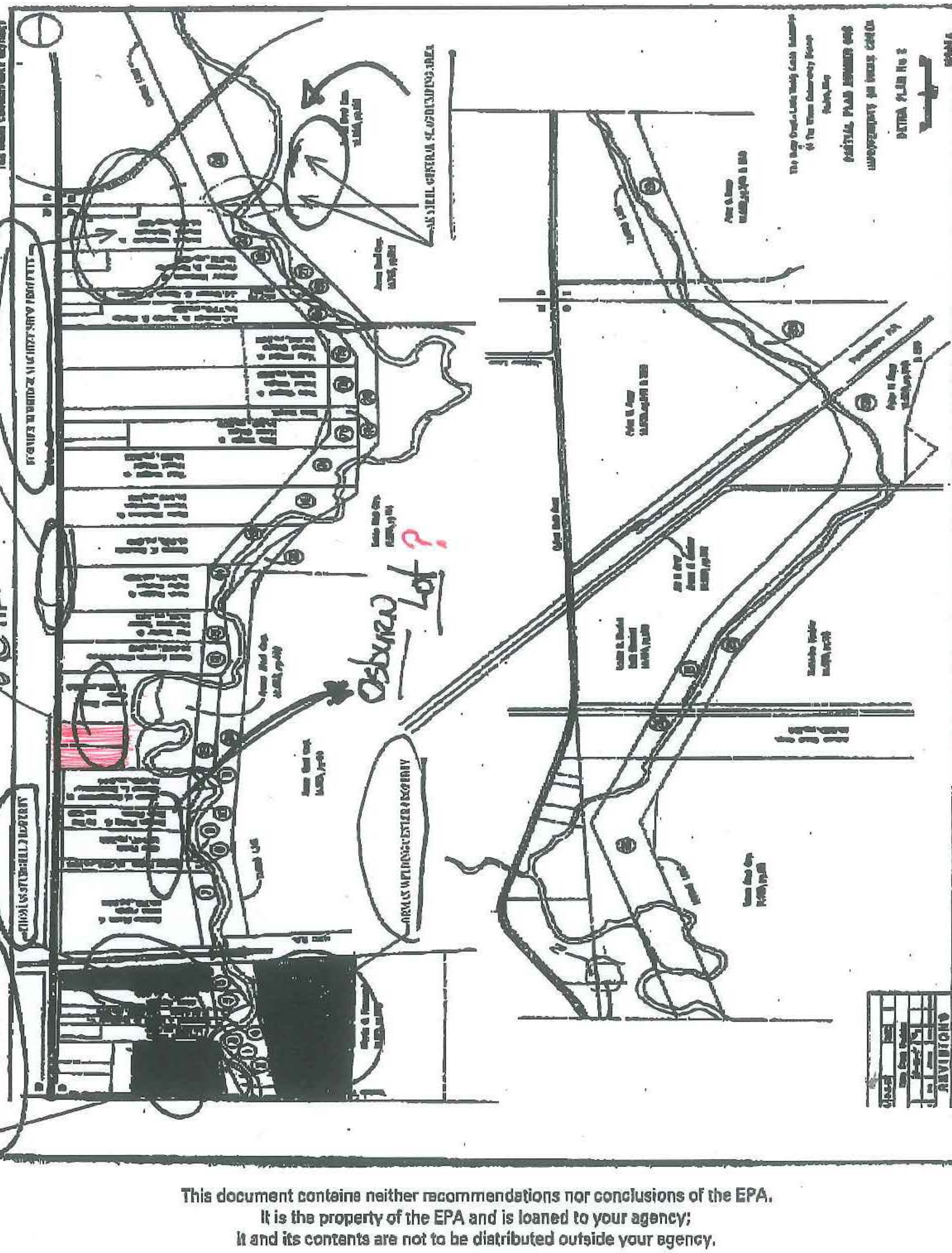
INVESTIGATIVE ACTIVITY REPORT

Figure 2

*Suspect Disposal Areas

4' fill over Pipelines??

Old Armco Lot??



*Disposal Area on AK/Armco Property at Oxford State Rd/Ottawa St
is not shown on map.

*4' Fill over Pipelines!!

Former Burnside Machine Shop Property (AOC 25)

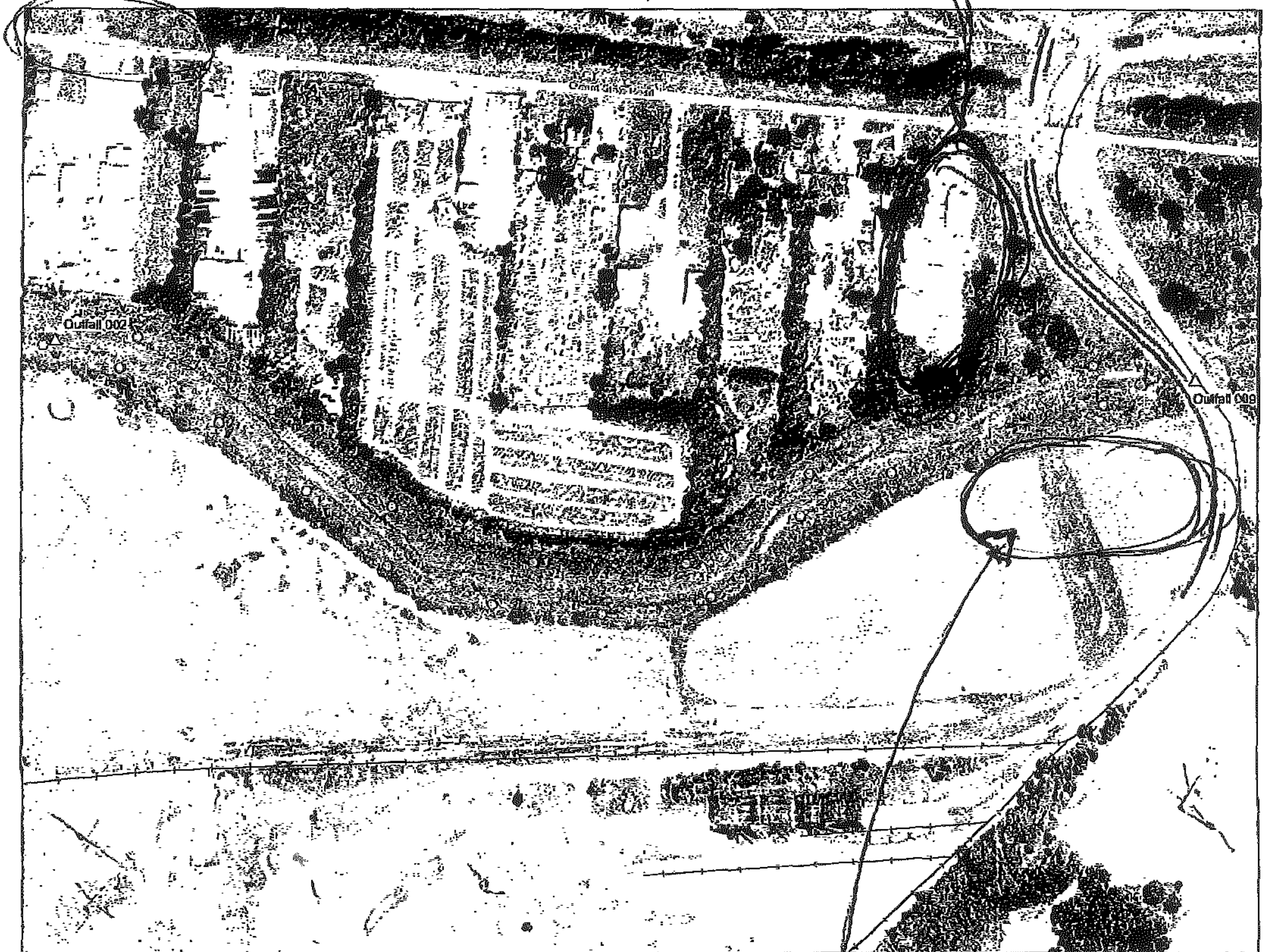


Figure 4
Outfall 2 to Slag Hauler Rd
Dick's Creek
Middletown, Ohio

Legend

- Proposed Sample Locations
- Proposed Deep Sample Locations
- Outfall
- Stream
- Roads
- Meanders_Pre1970
- RailRoads
- Flood Plane

Aerial Photograph purchased from TerraSearch Inc. Image is a 2003, .61 meter, full color aerial photograph georectified to UTM Zone 16N NAD83 Meters. Positions may vary in accuracy due to scale differences between the data sets. Spatial information is meant for general reference only.

Base Data are projected in Lambert Conformal Conic projection, 1983 North American Datum, Local coordinate grid State Plane Ohio (south) FIPS 3402.

Cartography by ARCADIS - Greenville, SC

AK Steel / General Slag Dumping Areas
(Part of SWMU 41)

4

U.S. ENVIRONMENTAL PROTECTION AGENCY

Special Litigation and Project Division
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COMMENTS: Arcadis Figures/Maps 2/3/4

NUMBER OF PAGES (INCLUDING COVER SHEET): 4

1

United States of America and The State of Ohio v. AK Steel Corporation

Civil Action No. C-1-00530
United States District Court
Southern District of Ohio, Western Division

EXPERT REPORT:

RESPONSE TO REBUTTAL REPORTS BY MARTIN HAMPER AND JOSEPH A. QUINNAN DATED MARCH 11, 2004

prepared for the
U.S. Department of Justice
Environmental Enforcement Section
Washington, DC

by
Gary R. Chirlin, Ph.D., PE
Chirlin & Associates, Inc.
16623 Bethayres Road
Rockville, MD 20855-2043

DRAFT DATED September 3, 2004

________________________________ ____________________

Gary R. Chirlin Date

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i. LIST OF FIGURES

1. INTRODUCTION

The United States has asked me to respond to two rebuttal reports that challenge my original expert report in this litigation ("Chirlin 2003")[1]. The two rebuttal reports for AK Steel were prepared by Arcadis G&M, Inc. employees Mr. Martin Hamper ("Hamper 2004")[2] and Mr. Joseph A. Quinnan ("Quinnan 2004")[3].

Section 2 addresses release detection issues and Section 3 addresses remedy issues.

[1] Chirlin, Gary R. (November 10, 2003). Expert Report: Surface-water and Groundwater Contamination at the AK Steel Works, Middletown, Ohio.
[2] Hamper, Martin (March 11, 2004). Rebuttal Expert Report, Rebutting Expert Report of Dr. Gary R. Chirlin, Surface-water and Groundwater Contamination at the AK Steel Works, Middletown, Ohio.
[3] Quinnan, Joseph A. (March 11, 2004). Expert Report: Rebuttal to Surface-water and Groundwater Contamination at the AK Steel Works, Middletown, Ohio.

2. RELEASE DETECTION ISSUES

Section 2 discusses issues related to release detection, including the adequacy of soil and groundwater monitoring.

2.1 TCE in well GM-27S

As described in Chirlin (2003 Sect. 3.2.3.3) and Hamper (2004 Sect. 3.3), trichloroethene has been detected in well GM-27S ever since the first sample was collected in 1989. The most recent (2003) concentration of 620 ug/l is the third highest of the fourteen years for which I have seen results (Chirlin 2003 Table 3-2). This plume does not appear to be dissipating of its own accord. Hamper (2004 Sects. 3.4, 5.13) apparently accepts the conclusions of a 1997-98 Arcadis study[4] in asserting that the source of this TCE lies somewhere offsite from AK Steel and that the plume is captured by onsite AK Steel production well 38. Chirlin (2003 Sect. 3.2.3.3) describes why due to inappropriate well locations and wellscreen depths the Arcadis study is wholly inconclusive concerning both local direction of groundwater flow within the intermediate aquifer and location of the source of TCE. Chirlin (2003 Sect. 3.2.3.3) also notes that the potentially most informative well in the vicinity, well K, was not sampled.[5] Hamper (2004) and Quinnan (2004) do not challenge the facts or logic of Chirlin (2003 Sect. 3.2.3.3).

Given the serious shortcomings of the Arcadis study it would be unjustified for any AK Steel risk assessment to presume an offsite (i.e., non-AK Steel) TCE source or to presume capture of the TCE plume by the plant production wells.

2.2 Coke Oven Gas Leak

Hamper (2003 pg. 24) states that I failed to include the results from wells DMW-7 and DMW-8 located on the east side of Ottawa Street in my analysis of the western extent of the plume created by the Coke Oven Gas leak. Indeed, although I considered these wells I failed to include them in a parenthetical list at Chirlin (2003 Sect. 3.2.1.11, penultimate paragraph, last sentence). My observation in that section remains intact, namely that no sufficiently closely spaced set of clean upper saturated zone wells exists along the western boundary of the COG spill area to conclude that the plume did not migrate west of Ottawa St.

For instance, the center of the south plume, as characterized by the 10 mg/l benzene contour, was believed to be heading northwest through the 280 ft-wide unmonitored zone between observation wells BW-3 (which did exhibit contamination) and DMW-2s (which did not).[6] Even after activation of extraction wells EW-1 and EW-4 the southern part of this most contaminated zone was believed to be heading offsite between the two

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[4] Arcadis Geraghty & Miller, February 6, 1998. Letter from R. Astle and L. Graves to J. McGinnis, OEPA re: Investigation of the Occurrence of TCE in Monitoring Well GM-27S, AK Steel Corporation, Middletown, Ohio. *In Frost & Jacobs LLP (12/3/99) Appendix J.*

[5] On October 15 or 16, 2003 (latest data) well K was monitored for water elevation (Arcadis February 3, 2004, Letter from D. Vicarel and J. Reid to J. McGinnis, OEPA re: Groundwater pumping and groundwater flow, July through December 2003, AK Steel Corporation, Middletown Works, Middletown, Ohio). Therefore it appears to be accessible for water quality monitoring purposes.

[6] Dames & Moore (July 23, 1998). Shallow Groundwater Investigation, Former Coke Oven Gas Pipeline Area, AK Steel Plant, Middletown, Ohio, Figs. 11 and 16

observation wells.[7] No data ever was collected further downgradient (west to northwest) of the central portion of this plume.

2.3 Flushing Liquor Spills

Hamper (2004 Sect. 5.9) objects to my conclusion that "Soil and groundwater have not been sampled at the flushing liquor spill sites, and therefore it is not known to what extent hazardous constituents were releases to soil and groundwater by these spills." However, the counterpoints raised in Hamper (2004 Sect. 5.9) do not make sense. Hamper (2004) notes that benzene was monitored in groundwater in two areas (the areas are unrelated to the flushing liquor spill sites), that the facility-wide program includes pumping to control offsite flow in the intermediate and lower aquifers (the flushing liquor spills would enter the upper aquifer), that facility-wide perimeter monitoring wells are relevant (no upper aquifer well monitors the Melt Area [Section 2.4]), and that the monitoring of Dicks Creek and Monroe Ditch seeps is relevant (monitoring points are remote and on the far side of Dicks Creek, and analytes do not include flushing liquor constituents).

2.4 Perimeter Groundwater Monitoring Network

Hamper (2004 pg. 27) asserts that the AK Steel facility-wide groundwater monitoring program is adequate to "take a 'big-picture' look and prioritize…resources based on risk to human health and the environment". Similarly, Quinnan (2004 pg. 12) states that "AK steel has developed a comprehensive groundwater management plan using state-of-the-art science and diligent management." On the contrary, for the following reasons the AK Steel groundwater monitoring program is not adequate to assess conditions within the Main Plant, not even in a "big-picture" sense.

(a) The well network installed at Armco by Geraghty & Miller ("G&M") in 1989-1990 was designed to interpret geology and to measure plant-wide water levels,[8] not to detect releases. Apparently no consideration was given to locating wells downgradient of suspected sources of contamination—or indeed even to identifying such sources.
(b) The number of wells is woefully inadequate to monitor the many potential release sites in the main plant at AK Steel.
(c) The periodic groundwater sampling at AK Steel deliberately excludes most wells in the interior of the Works: except within the OMS Area the monitoring network consists almost entirely of wells that are along the Works boundary (Figure 1).[9, 10, 11, 12] Hamper (2004 pg. 7) refers to this program as "perimeter groundwater monitoring". Clearly, these wells are remote from many potential sources.

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[7] Ibid., Figs. 14 and 17

[8] Geraghty & Miller, Inc. (May 1989). Investigation of Groundwater Flow Conditions at the Armco Plant, Middletown, Ohio, pg. 6

[9] When the sampling program was designed in 1989-1990 G&M chose to characterize only the groundwater around the boundary of the Works property (Geraghty & Miller, Inc. May 1990. Compilation of the November 1989 and March 1990 Groundwater Quality Investigations at Armco Steel Co. L.P., Middletown, Ohio, pg. 2). This monitoring strategy has persisted at least through 2003 (Quinnan 2004 App. C, Table 1).

[10] Geraghty & Miller, Inc. (May 1990). Compilation of the November 1989 and March 1990 Groundwater Quality Investigations at Armco Steel Co. L.P., Middletown, Ohio, Table 5.

[11] Ohio Environmental Protection Agency (December 1, 1999). Letter from C. Jones to F. Lyons, Regional Administrator, USEPA Region V. Attachment 4c.

(d) In addition, if the containment system is working then the intermediate and lower aquifer monitoring wells along the boundary only sample waters coming into AK Steel. In essence, AK Steel does not monitor the quality of intermediate or lower aquifer groundwater within its property and therefore has no idea whether contamination exists in these units! Only the upper aquifer wells (and arguably a couple of slightly interior deeper wells; see Figure 1) actually sample AK Steel groundwater.

(e) Production well water is not sampled for potential contamination; thus even if a plume is being captured it is not perceived. Hamper (2004 pp. 28-29) correctly notes that production wells are not ideal monitoring wells. This is true particularly because of their potential for yielding false negative results (not detecting existing contamination). Nevertheless, sampling the plant wells would be a useful first cut at assessing groundwater quality inside the Works.

As an example of monitoring inadequacy, consider the spill-prone Melt Area. There are only five sampled well nests anywhere near to the Melt Area.[13] All five are along the western boundary of the Works and are spaced over 1000 feet apart on average (Figure 1). Four[14] of the nests contain only intermediate and/or lower aquifer wells and therefore sample only offsite groundwater, assuming that the containment system works. The remaining well (GM-04S) intercepts only a tiny fraction of the water passing beneath the Melt Area. Contamination in GM-04S triggered the Benzene Investigation, and even this one remaining Melt Area water quality well—at last look still contaminated by 1,2-dichloroethene[15]—apparently no longer is being sampled.[16] That leaves no wells sampling the groundwater of the Melt Area at AK Steel.

Chirlin (2003 conclusions 5, 6, 7) also addresses inadequacies of the AK Steel monitoring program. In summary, as currently conceived the AK Steel groundwater monitoring strategy consists of not looking for trouble, and accordingly mostly not finding it.

Quinnan (2004 pp. 11, 14,15) objects to my "broad implication that there are potentially unknown plumes at the Middletown Works" and my "speculation for the existence of

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[12] Figure 1 omits three intermediate aquifer boundary wells which were sampled once in April 1991: GM-03S in the Coil Paint Plant and GM-10S, GM-11S along the south boundary of the Main Plant (Geraghty & Miller May 21, 1992, Presentation of Results of Ground-Water Monitoring and Benzene Investigation, Armco Steel Co., L.P., Middletown, Ohio. Presented to OEPA SW District Office, Tables 1, 7).

[13] The downgradient direction beneath the Melt Area differs depending on aquifer and, for the lower two aquifers, on which deep wells are active (G&M May90 Figs. 2-7; OEPA 01Dec99 Att. 4c, Figs. 1-3). Here I do not include the monitoring wells installed in response to spills at the COG pipeline leak area and the Benzene Investigation area.

[14] Initially Melt Area well GM-09S was deemed screened in the intermediate aquifer (e.g., G&M May 1989 Fig. 23), then in the upper aquifer (e.g., G&M May 21, 1992 Table 1; OEPA 01Dec99 Att. 4c Fig. 1), then again in the intermediate aquifer (e.g., Arcadis G&M 05Sep01 Dwg. 2).

[15] OEPA 01Dec99 Att. 4c; Quinnan (2004 Table 2).

[16] According to Quinnan (2004 App. C Table 1) GM-04S is not included in the annual monitoring rounds. In agreement, the most recent round of water quality results that I have obtained (1st half 2001) did not include GM-04S (Arcadis, September 5, 2001. Letter report to J. McGinnis, OEPA re: Groundwater Pumping, Groundwater Flow, and Groundwater Quality, AK Steel Corporation, Middletown Works, Middletown, Ohio). Quinnan (2004, Table 4) indicates that a sample from GM-04S was collected and analyzed for (only?) benzene in 2000, but not in the three more recent annual rounds.

unknown plumes". However, the inadequate monitoring network, strict records-destruction policy of AK Steel (when Armco), use and production of hazardous substances, multiple known releases at the Works, and history of groundwater contamination remaining undetected for years at the Works, all indicate that the only responsible assumption is the existence of undiscovered releases of hazardous substances. Quinnan's (2004 pg. 15) optimistic presumption to the contrary is not justified.

Hamper (2004, pp. 9-10, 11-12) invokes the USEPA's Migration of Groundwater Under Control Environmental Indicator ("GW EI") strategy and the USEPA results-based holistic approach in arguing the sufficiency of the current groundwater monitoring network at AK Steel. Of course this is ultimately an agency decision, but I do not agree that the GW EI program or holistic approach justifies the Hamper (2004) conclusion.

The GW EI program consists of short term protection objectives and actions addressing the first and most lenient of the three goals of RCRA corrective action.[17] In order to achieve a positive (acceptable) GW EI a facility must assess groundwater plume stability and impacts to surface water. At AK Steel essentially no information is collected on the groundwater quality of the intermediate and lower aquifers beneath the Works; therefore it is not possible to even identify, much less to assess the stability of, any intermediate/lower groundwater plumes at the Works. USEPA does not encourage sparse monitoring, and indeed makes it clear that simply to achieve the modest threshold of a positive GW EI a facility "should understand **where** the current three-dimensional limit of the plume is, as defined by levels of concern, and **where** the facility will monitor groundwater to demonstrate that they achieved and will continue to achieve the prevention of further migration of contaminated groundwater above levels of concern".[18, 19]

To me it seems unlikely that USEPA intends that facilities evade monitoring for releases downgradient of likely source areas by adopting the GW EI or holistic approaches, or that USEPA will countenance as permanent a remedy containing long multi-aquifer groundwater plumes intercepted by industrial water supply wells.[20] Either Mr. Hamper and Mr. Quinnan are claiming that a facility-wide, holistic corrective action justifies nearly complete ignorance of the presence and distribution of groundwater contamination within the facility boundaries, or they, too, must find the current groundwater monitoring network at AK Steel to be inadequate.

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[17] USEPA (April 2004) Handbook of Groundwater Protection and Cleanup Policies for RCRA Corrective Action, EPA530-R-04-030. Available at http://www.epa.gov/epaoswer/hazwaste/ca/resource/guidance/gw/gwhandbk/gwhb041404.pdf

[18] Ibid., pg. 2.3

[19] USEPA requires that monitoring locations define the plume (USEPA Groundwater EI Slides at http://www.epa.gov/epaoswer/hazwaste/ca/eis/slides/gwei.pdf, Slide 13).

[20] Under the Groundwater EI approach USEPA requires that a stabilized body of contaminated groundwater remains "within the original area of contaminated groundwater" (USEPA Groundwater EI Slides at http://www.epa.gov/epaoswer/hazwaste/ca/eis/slides/gwei.pdf, Slide 5). Although this definition is not particularly illuminating, I am skeptical that USEPA envisioned "original area" as a plume extending several thousand feet through two aquifers from a surface source to an industrial water supply well.

2.5 OMS Area

Quinnan (2004 pp. 3-4, 8-9) states that the polychlorinated biphenyl ("PCB") source areas within OMS Area have been "fully delineated", that my claim to the contrary is "almost ridiculous", and that "no further investigation is warranted". I have discussed this matter in considerable detail in Chirlin (2003 Sect. 3.2.5). But perhaps most telling is AK Steel's failure, after the many years of investigations, to produce contour maps of the spatial concentration of PCBs in soil in the OMS Area. Such maps generally are the culmination of meaningful source assessment and the precursor of informed remedial action.

Here are some examples of the ambiguity and inconclusiveness of source identification studies to date in the OMS Area.

(a) PCBs were detected in soils and groundwater adjacent to a concrete pad-mounted electrical transformer. The source of PCBs has not been determined or even discussed in reports I have seen; therefore it is not known whether the samples represent peak concentrations or fringe values at this release site. No remedial action has been taken. (Chirlin 2003 Sect. 3.2.5.5.1)

(b) PCBs were detected in soils adjacent to a pole-mounted electrical transformer. The source of PCBs has not been determined or even discussed in reports I have seen; therefore it is not known whether the samples represent peak concentrations or fringe values at this release site. No groundwater samples have been collected. No remedial action has been taken. (Chirlin 2003 Sect. 3.2.5.5.2)

(c) Mill Scale Area 3, a PCB source area, is mapped inconsistently in Arcardis documents as in one case equal to, in another case much larger than, the former Bone Yard. Certain borings attributed to Mill Scale Area 3 actually are in SWMU 40. (Chirlin 2003 Sect 3.2.5.6.2)

(d) PCBs have been discovered in the northwest corner and east side of solid waste landfill SWMU 39 ("South Landfill"). PCBs are not expected in these areas based on AK Steel's theory of PCBs disposal with purchased mill scale. AK Steel has not provided any explanation or even discussed this anomaly in reports I have seen. DNAPL has been detected in well MDA-33S on the east side of SWMU 39 yet it has not been sampled. One possible source of the DNAPL—which may contain hazardous substances—is the former disposal ponds west of Monroe Ditch. (Chirlin 2003 Sections 3.2.5.9, 3.2.5.10)

(e) The highest PCB concentrations in the vicinity of the Former Oil Separator Ponds were found not within former pond footprints or in the overflow surface drainage ("Former Drainage Swale"), but rather in an area north of the westernmost large pond. The Arcardis theory of PCBs release in the pond oils does not explain this occurrence. AK Steel has not provided any explanation or even discussed this anomaly in reports I have seen. (Chirlin 2003 pg. 3-47)

(f) PCBs have been detected in seeps along the south bank of Dicks Creek. PCBs are not expected in this area based on AK Steel's theory of PCBs disposal with purchased mill scale. AK Steel has not provided any explanation or even discussed this anomaly in reports I have seen. (Chirlin 2003 Sect. 3.2.5.18.1)

(g) Finally, I note again that the Arcadis documentation of OMS Area investigations contains numerous inconsistencies and other errors which I describe in footnotes 68, 71, 72, 73, 75, 76, 78, 79, 80, 81, 82, 83, 85, 86, 99, 100, and 101 of Chirlin (2003). Most of these items concern sampling locations and results. I continue my request for clarifications or corrections.

Quinnan (2004 pp. 4-5) opines that groundwater transport of PCBs from the Former Drainage Swale has been adequately investigated. I disagree. The highest PCBs concentrations in soil along the Former Drainage Swale occurred approximately midway between the ponds and Monroe Ditch. According to Arcadis (08Feb02 Figs. 16-19) potentiometric contours, perched groundwater flow in this vicinity proceeds generally south-southwest beneath the elevated railroad tracks into an area unexplored by AK Steel monitoring. Quinnan (2004 pp. 4-5) and Arcadis (08Feb02 pp. 57, 93, Fig. 6) infer that a trough exists in the basal clay beneath the perched zone and that this trough redirects flow westward toward a sampled area adjacent to Monroe Ditch (MDA09P/S, seeps #5, #6).[21] However, site data indicate that no trough exists and that groundwater flow continues to the south-southwest.[22] The fate of these PCBs is therefore also unexplored and unexplained. (Chirlin 2003 Sect. 3.2.5.16)

Quinnan (2004 Sect. 6.1) argues that PCB assessment and existing remedies are sufficient within the OMS Area. I remain concerned that no assessment has been conducted of PCB release to Monroe Ditch or Dicks Creek via subsurface discharge ("submerged seeps") or of downstream migration of PCB-contaminated sediments during stormflow. (Chirlin 2003 Sect. 3.2.5.17.4)

2.6 Monroe Ditch and Dicks Creek Sediments

Hamper (2004 pp. 7-8) opines that AK Steel's voluntary facility-wide investigations and corrective actions are adequate to address risks to human health and the environment. However, AK Steel field data have a serious blind spot concerning PCBs contamination within dredge spoil fill from Dicks Creek. Lacking this information it is premature to draw conclusions on risks to health and environment.

Substantial dredging, rerouting and channelization of Dicks Creek was performed by Miami Conservancy District ("MCD") during summer-autumn 1967. Planning documents suggest that during the 1967 event an estimated 793,000 yd^3 of spoil was generated from Dicks Creek (Yankee Rd. to Cincinnati-Dayton Road [old US 25]), 166,000 yd^3 from North Branch Dicks Creek,[23] and 100,00 yd^3 from Jackson Lane Drainage Ditch.[24, 25]

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[21] I assume that "south-southeast" in Quinnan (2004 pg. 5, 1st paragraph) should be "south-southwest".

[22] Arcadis data indicate that no trough exists. The inferred trough in the clay in Arcadis (08Feb02 Fig. 6) is driven by an anomalous clay elevation at boring MDA24PR. At that location the clay is about 10 feet higher than would be expected absent a trough. But Arcardis (08Feb02 Fig. 6) omits clay elevation data from immediately adjacent boring BH-24P and nearby borings BH-10 and BH-12, and ignores the previously inferred clay elevation therefrom (Arcadis 15Jul99 Figs. 11, 13; Arcadis 08Feb02 App. B). These three omitted borings encountered the clay about 10 feet deeper than at MDA24PR, and Arcadis accordingly previously concluded that the clay was at this deeper elevation (Arcadis 15Jul99 Figs. 11, 13). Given these data one must consider the observed 1-foot thick shallow clay at MDA24PR to be a very localized lens not indicative of a trough feature. Rather, the clay surface appears to decline west to east more or less as a plane from the Former Ponds to Monroe Ditch.

[23] North Branch Dicks Creek originally flowed from the northeast corner of AK Steel, west-southwest to south-southwest across the eastern half of the Main Plant, and joined Dicks Creek

Jackson Lane Ditch is the north-south channel through the Main Plant that empties through current Outfall 003 to Dicks Creek.

The disposition of the fill is not fully described in the documents I have reviewed. Apparently as early as February 1966 (but definitely before September 1966) Armco specified four available fill areas within the Main Plant.[26] In May 1967, which may still have preceded any work in the field, Armco offered three fill area locations within the Main Plant. Two of those areas are between the Basic Oxygen Shop and the Hot Strip Mill, and the third is in the southeast corner where North Branch Dicks Creek discharges to Dicks Creek.[27] It is unclear whether any fill initially was deposited in these areas. It is clear that the dredging contractor Holloway Construction Company deposited spoil in unauthorized areas along both sides of Dicks Creek some time prior to July 8, 1967. As a consequence during September 21-October 24, 1967 Holloway hauled 103,560 yd^3 of spoil "to Armco from areas along Dicks Creek".[28] Of this total approximately 64%, or 65,800 yd^3, was placed at Armco prior to an October 10th letter from MCD conveying Armco's October 3rd revised map of available fill areas.[29] These new areas partially overlapped the previous areas and may have been identified because most of the original areas were full, but this is not explicitly stated in the documents I have reviewed.

The 1967 Dicks Creek dredge and fill activities were occurring approximately six years after Armco began depositing and processing wastes at its newly created Slag Processing Area south of Oxford State Road (Chirlin 2003 footnote 10).

The hydraulic capacity of Dicks Creek quickly diminished due to sedimentation plus local erosion and channel shifting. A special maintenance project in 1975 by MCD Dicks Creek-Little Muddy Creek Subdistrict used a dragline to remove silt deposits and

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just east of current Outfall 003. The North Branch Diversion Ditch which replaced it follows a completely different path. (Miami Conservancy District, October 10, 1967, Sheet 1 of 41).

[24] Miami Conservancy District (May 28, 1964). Dicks Creek Preliminary Estimate. 24 pages. Attached to USEPA (February 4, 2004) Office of Criminal Enforcement, Forensics and Training, Civil Investigator Team-Chicago Detachment. Memo from R. Arkell to R. Guenther, Office of Regional Counsel, Region 5.

[25] Miami Conservancy District (October 10, 1967) Letter from J. Mitchell to Holloway Construction Company re: Contract No. 142 – Dicks Creek, Middletown, Ohio, with drawings MCD Sheet 1 of 41, Armco SK-1278-C, Armco SK-1279-C. Attached to USEPA (February 4, 2004) Office of Criminal Enforcement, Forensics and Training, Civil Investigator Team-Chicago Detachment. Memo from R. Arkell to R. Guenther, Office of Regional Counsel, Region 5.

[26] Miami Conservancy District (October 10, 1967) Letter from J. Mitchell to Holloway Construction Company re: Contract No. 142 – Dicks Creek, Middletown, Ohio, with drawings MCD Sheet 1 of 41, Armco SK-1278-C, Armco SK-1279-C. See Drawing MCD Sheet 1 of 41, particularly the x'd out text box and fill areas. Attached to USEPA (February 4, 2004) Office of Criminal Enforcement, Forensics and Training, Civil Investigator Team-Chicago Detachment. Memo from R. Arkell to R. Guenther, Office of Regional Counsel, Region 5.

[27] Armco (May 10, 1967) Letter from R. F. Boschert to M. Mitchell, Miami Conservancy District, with drawings SK-1231 and SK-1232. All are attached to USEPA (February 4, 2004) Office of Criminal Enforcement, Forensics and Training, Civil Investigator Team-Chicago Detachment. Memo from R. Arkell to R. Guenther, Office of Regional Counsel, Region 5.

[28] Miami Conservancy District (October 27, 1967). Computation Sheet re: Dirt Hauled to Armco by Holloway. Checked by R. Fogle. Note: Total loads addition is incorrect; result should be 3452.

[29] Miami Conservancy District (July 19, 1967) Letter to Holloway Construction Co. re: MCD Contract 142, Lower Dicks Creek; Armco (October 5, 1967) Letter from R. Boschert to W. J. Linder, Miami Conservancy District; Miami Conservancy District (October 10, 1967) Op. cit.

meanders and to create a stable low-flow channel. The contractor encountered many problems with the dragline sinking into swampy beach areas. For this reason the material from the low-flow channel was spread over the beach areas and allowed to dewater. However, that material then reduced channel capacity and, lacking proper grading, caused portions of the beach area to remain swampy and impossible to mow. A 1983 assessment suggested further remedies for the channel degradation.[30] As a result during July-October 1984 MCD supervised a second special maintenance project to remove 22,180 yd^3 of accumulated sediment from beach areas between Yankee Road and the Armco culverts, and to install field drains in the swampy areas downstream of Shaker Creek.[31] Daily Construction Reports describe areas of spoil filling associated with this activity. These included the rear of an Oxford State Road lot (August 6, 14, 15, 16); over the Standard Oil & C.G.&E. lines to a thickness of four feet (August 14); Armco (August 15); the lot behind Burridge Machine Shop (August 16, 21); upstream scours (August 16); the Middletown Welding Co. lot (August 21); an Armco lot, left side of stream (September 6); Oxford State Road and Ottawa Street (September 8); and the private lot of Cecil Osburn on Oxford State Road (September 13).

For more than a month during 1991 the MCD special maintenance crew used a trackhoe, frontend loader, dump truck and bulldozer to clean out North Branch Dicks Creek. Work also was started on the main channel near Dayton-Cincinnati Rd., and additional work was scheduled for 1992.[32]

Given that PCBs have been found in the sediments of Dicks Creek, it is likely that the dredge and fill actions of 1967 through 1991 unwittingly conveyed PCB-laden sediment to dredge spoil fill areas. If so, these areas constitute reservoirs of PCBs that may pose risks. For instance, spoil areas within the floodplain of the creek can release PCBs directly to the creek(s) during erosive flooding events. Spoil areas farther from the creek also may erode during storms and contribute PCB-bearing particles to storm drainage that reaches the creeks. To my knowledge no sampling has been conducted of known or suspected dredge spoil fill areas at AK Steel.

[30] 1975 Chief Engineer's Report, pp. 24-25; 1976 Annual Report of the Miami Conservancy District, Dayton, Ohio to Common Please Court of Montgomery County, Ohio, pg. 10; Rinehart, Kurt A., September 1983, Review of Modified Partial Plan Number One, Dicks Creek-Little Muddy Creek Subdistrict, Dicks Creek Channel, Sect. IIIA.

[31] Unattached page 39 with paragraph headed "Dicks Creek Channel – Contract No. 84-029C-170320".

[32] 1991 Annual Report of the Miami Conservancy District, Dayton, Ohio, to Common Pleas Court of Montgomery County, Ohio, pg. 12.v

3. REMEDY ISSUES

This section addresses remedy issues raised by Hamper (2004) or Quinnan (2004). Section 3.1 concerns the plant-wide groundwater capture system, and Section 3.2 addresses the coal tar decanter sludge storage area at the Robin Hood Coal Pile.

3.1 Plant-wide Groundwater Capture System

Hamper (2004 pp. 6, 22) opines that the AK Steel facility-wide intermediate and lower aquifer groundwater control program "is effective in capturing groundwater at the site…to prevent off-site migration of any hazardous constituents which may be present". In this opinion he apparently relies wholly on Quinnan (2004). Hamper (2004 pg. 6) then notes that "Dr. Chirlin did not state why he did not conduct this important review [of this AK Steel groundwater control program]".

Dr. Hamper is correct that in my expert report I intentionally did not review the efficacy of the AK Steel groundwater containment program. I did not assess whether the wells indeed capture the targeted waters because I did not—and do not—feel that this containment system and its companion groundwater quality monitoring program are an adequate mechanism for managing the long-term risk of contaminant migration from AK Steel. My reasons are described below in Section 3.1.1. Nevertheless, in response to Quinnan [2004] I have now evaluated the extraction network—my findings are presented in Section 3.1.2.

3.1.1 Unsatisfactory Remedy

The Works' pumping wells function principally for water supply. Based on numerical modeling performed during 1989-1991, AK Steel has tweaked extraction rates in order to capture all intermediate and deep groundwater within the footprint of the Works. More recently extraction rates from most wells have greatly exceeded those assumed in the modeling, presumably due to higher industrial demand. Nevertheless the AK Steel water supply well network is not an appropriate long-term remedy for control of onsite contamination and protection of this important water supply aquifer.

(1) **IMPERMANENCE.** The pumping network does not constitute a long-term solution even if one grants that its intermediate/lower zone of capture currently includes the entire Works. The current zone of capture is simply a fringe benefit of current plant operations. A large volume of water (approximately 3000 gal/min) is being withdrawn by AK Steel.[33] Because this water production exceeds that suggested by the numerical model, it is clear that total withdrawal is driven by operational needs, not by zone of capture requirements. To my understanding AK Steel has not agreed to pump indefinitely at such rates at this site, nor has it funded an entity to do so in its absence (for instance, if the plant closes).[34] Therefore any current containment must be viewed as fortuitous rather than remedial and cannot not be relied upon for long-term risk reduction.

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[33] Quinnan (2004 pg. 13, Table 3)

[34] Dr. Quinnan takes care to restrict his statement of support for the strategy to "so long as AK Steel continues its ongoing site-wide groundwater monitoring and pumping program" (Quinnan 2004 pg. 15).

(2) HARM. All AK Steel pumping wells are open only to the lower aquifer. These wells each draw in water from thousands of feet away and through at least two hydraulically interconnected aquifers (intermediate and lower). Therefore every release at AK Steel which reaches the intermediate aquifer is induced to spread through both the intermediate and lower aquifers, and—unless a release happens to be close to one of the production wells—a lengthy plume is created. Unless one views the groundwater system beneath the Works as expendable, this strategy unacceptably creates and sustains long, multi-aquifer plumes.

(3) RISKS OBSCURED BY INADEQUATE MONITORING. The existing monitoring well network at AK Steel is not adequate to detect releases (see Section 2.4), and therefore the risks posed by the current containment system (which arise if it is leaky or temporary) cannot be meaningfully evaluated.

3.1.2 Zone of Capture Defects

AK Steel has consistently claimed that its groundwater extraction system, as currently operated, captures all intermediate and lower aquifer groundwater within the Works footprint. AK Steel argues that any known or unknown releases of hazardous substances to these aquifers within the Works will not escape the Works. The area within which groundwater is drawn to a pumping well is known as the Zone of Capture ("ZOC"). A network of pumping wells, such as exists at AK Steel, has a composite ZOC. In a multi-aquifer system, such as exists beneath AK Steel, the ZOC of each aquifer is distinct.

In response to Quinnan (2004 Sect. 6.2) I have reviewed the efficacy of the AK Steel groundwater extraction system for capture of intermediate and lower aquifer groundwater. I have determined that due to possible interpretive errors in bedrock topography beneath and southwest of the Melt Area and due to errors and uncertainty in stratigraphic interpretations and in water elevation contours, the intermediate aquifer groundwater may flow offsite from beneath the Melt Area.

The following discussion addresses this concern. It begins by finding no basis for an inferred finger of bedrock forming the intermediate and lower aquifer boundaries WSW of the Melt Area. It continues by pointing out the limited area within which reliable stratigraphic or potentiometric data area available on the intermediate aquifer. In particular this does not include the South Plant or the COG pipeline area. Even beneath the Melt Plant where several borings have been drilled, the lateral continuity of intermediate aquifer materials is poorly understood. It concludes with discussion of the potentiometric surface and implied direction of flow within the intermediate aquifer.

Bedrock topography. The bedrock topographic surface developed by Armco contractor Geraghty & Miller ("G&M") and used in its groundwater flow model[35] may substantially understate the depth to bedrock and therefore the thickness and extent of the lower and intermediate aquifers beneath and southwest of the Melt Area. There are two reasons for drawing this conclusion.

(1) In reviewing the data used by G&M (May 1989 Fig. 20) to infer existence of a ridge of bedrock beneath the Melt Area, I found that a USGS document relied upon by G&M

[35] Geraghty & Miller, May 1989, Investigation of Ground-Water Flow Conditions at the Armco Plant, Middletown, Ohio, Figure 20, pp.49, 83-85, Table 2. This document is cited numerous times and is abbreviated as G&M May 1989.

may err in boring locations and bedrock depths. Most significant to the ridge inference is an undocumented 460 ft msl bedrock elevation approximately 2300 ft NW of MW-6-84.[36, 37, 38, 39] The upshot of possible errors is that G&M's inferred bedrock ridge trending SW-NE from the mouth of Monroe Ditch, beneath the former #2 open hearth building, and nearly to Lefferson Rd. may not exist. Correspondingly, there may be no ancestral tributary valley south of the Melt Area (contrary to G&M May 1989 pg. 58). Rather, the entire area of the inferred ridge may have bedrock at sufficient depth to host the intermediate and lower aquifer aquifers (contrary to G&M May 1989 and derivative documents). If that is the case, then the southwest boundary of the intermediate and lower aquifers used in AK Steel models and potentiometric surface maps does not exist. Instead, both units extend farther to the southwest. Groundwater flow within one or both may flow southwest from the Melt Area toward the Great Miami River rather than into plant pumping wells as deduced from the G&M model.[40]

(2) Even if the posted bedrock elevation of 460 ft msl is correct, there is no apparent reason for G&M to have inferred the existence of a bedrock ridge trending SW-NE from the mouth of Monroe Ditch, beneath the former #2 open hearth building, and

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[36] This ridge feature appears to be "driven" by a single data point, namely an observed bedrock elevation of 460 ft msl located just below the words "SCRAP PREP" on G&M (May 1989 Fig. 20). All other elevation points in the vicinity are "no greater than" values obtained from borings which did not reach bedrock, as indicated by the negative sign and the figure note. The 460 ft elevation value—like other values indicated by solid triangles—was taken from Watkins, J.S., and A.M. Spieker (1971, Seismic Refraction Survey of Pleistocene Drainage Channels in the Lower Great Miami River Valley, Ohio, USGS Prof. Pap. 605-B, Plate 1-East Half). In the USGS plate the value of 460 is attached to a point whose location does not correspond to any of the AK Steel wells shown in documents that I have reviewed (e.g., G&M May 1989 Figs. 3, 20, App. A). The companion USGS document Spieker, A.M. (1968, Ground-Water Hydrology and Geology of the Lower Great Miami River Valley Ohio, USGS Prof. Pap. 605-A) also does not post the well in its Plate 1 but lists some unposted Armco test wells in its Table 10, so perhaps the 460 value corresponds to one of those early test wells. Further inquiry requires access to the test well logs. One possibility is that the 460 data point actually refers to Armco well 34 which is 2400 ft away, also has a bottom elevation of 460 (based on the 670 ft ground elevation used by Spieker 1968 Table 10 for other plant production wells, and on G&M May 1989 App. A), did not encounter bedrock, was drilled in 1962 and is not otherwise included in the USGS plates.

[37] A nearby USGS point with posted elevation 408 ft msl and no known corresponding AK Steel well also requires verification. Perhaps this point actually refers to AK Steel well #23 which is 1000 feet away, did not encounter bedrock at a bottom depth of 407 ft, and was drilled in 1949.

[38] Unlike the other USGS data transcribed from Watkins and Spicker (1971 op cit. Plate 1) to G&M (May 1989 Fig. 20), a point with posted bedrock elevation of 568 ft msl is excluded by G&M without explanation. However, nearly coincident well MW-6-84 drilled much later (in 1984), which encountered no bedrock to 530 ft msl, is included in the G&M figure. This indicates that in even G&M's opinion the USGS elevation data are not always reliable.

[39] Well #35 data also is questionable. The USGS posted bedrock elevation is 418 ft msl whereas the well log indicates that no bedrock was encountered to the bottom elevation of 433 ft msl. Again, perhaps one of the uninspected test well logs corresponds to this location.

[40] To complete this particular inquiry I would determine the source and legitimacy of the USGS bedrock elevations. I would also examine a well log for nearby observation well #26 which is not documented in G&M (May 1989 App. A). Finally, I would examine Shoecraft, Drury and McNamee (1943, Report on Water Resources, The American Rolling Mill Company, Middletown, Ohio) to determine if well logs therein are relevant (G&M May 1989 pp. 49, 84). If the G&M bedrock topography is incorrect or indeterminate then the bedrock contour map should be revised and the impact on flow and modeling results explored.

nearly to Lefferson Rd. Adhering to the same 460 ft msl data point, Watkins and Spieker[41] infers a northward continuation of a ridge that outcrops in the Slag Processing Area southeast of GM-30 (G&M May 1989 Fig. 20) and passes beneath wells #27 and MW-6-84. That alternative ridge underlies the east side of the Melt Area, east of most of the identified SMWUs within the Melt Area. It does not create a west-side boundary to groundwater flow from the Melt Area in the intermediate or lower aquifer. A third plausible interpretation is that a ridge extends from the north (say, from the vicinity of GM-20D) to the 460 ft msl data point, rather than from the south. It, too, would not interfere with intermediate or lower aquifer flow from the Melt Area.

Spatial extent of reliable data. Subsurface data on the hydrogeology of the intermediate aquifer is very limited or completely absent in South Plant and in the COG pipeline spill area. It is more reliable, but still inconclusive, elsewhere beneath and west of the Melt Plant.

(1) The intermediate aquifer is poorly defined beneath the South Plant due to the lack of reliable subsurface information. Within the South Plant area all subsurface borings deeper than the upper aquifer were either production wells or test borings for production wells. It does not appear that a geologist was present for these events, and where side-by-side comparisons can be made there are numerous inconsistencies.[42] This is not unusual; wells logged by a driller often do not produce logs of sufficient detail or accuracy for hydrogeologic investigations.

Oddly, G&M ignores its own findings on this matter. G&M's north-south geologic cross-section (C-C') through the center of South Plant lacks any intermediate aquifer material whatsoever. Yet G&M includes the area in its potentiometric maps of the intermediate aquifer (at least until very recently). I note that the absence of intermediate aquifer materials in cross-section C-C' appears to be based solely on a driller's log from production well 39 (G&M May 1989 Fig. 22)[43] and therefore is untrustworthy.

(2) The intermediate aquifer has not been adequately explored beneath the vicinity of the COG pipeline spill area. Borings did not go deeper than about 603 ft msl (GM-09S).[44] The intermediate aquifer may lie at a slightly deeper elevation, particularly if the G&M-inferred bedrock finger discussed above does not exist. As is discussed below, water elevation data imply that none of these wells monitors the intermediate aquifer.

(3) Within and west of the Melt Area the intermediate aquifer is identified by G&M beneath and immediately west of the Melt Area, including at geologist-logged borings

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[41] Watkins, J.S., and A.M. Spieker 1971 op. cit., Plate 1

[42] I am aware of both a driller's log and a test well log for two locations at AK Steel, and the pairs contain inconsistencies (G&M May 1989 App. A). At production well #36/test well #62 the driller's log fails to detect three sand and gravel layers of three ft, one ft, and 5 ft thickness. At production well #37/test well #66 sand or sand and gravel is reported in only one of the two logs for two different intervals of 39 ft (production well only) and 20 ft (test well only) in thickness.

[43] Perhaps a test well was drilled and logged at the location of #37; AK Steel may know.

[44] G&M May 1989 Table 2, App. A; Dames & Moore, July 23, 1998, Shallow Groundwater Investigation, Former Coke oven Gas Pipeline Area, AK Steel Plant, Middletown, Ohio, Figs. 3, 4, 5

GM-14S, 15S, 16S, 08S, 07S, and 05S. However, it seems unlikely that these wells monitor a single lithologically continuous or hydraulically well-connected unit.

The intermediate aquifer (which is actually the uppermost aquifer over much of the Works) is defined stratigraphically by G&M as having an upper boundary somewhere between near surface and 55 ft bgs and a lower boundary (a confining unit) somewhere between 50 and 75 ft bgs. Saturated thickness is typically 10-20 ft in most areas of the Works but only 2-4 ft in the Melt Area. The aquifer material is in general terms sand and gravel, but in the Melt Area it varies greatly both vertically and horizontally from silty sand and gravel (up to 40% silt) to dominantly sand. Water levels are said to be approximately 50 to 60 ft bgs. (G&M May 1989 pp. 51-53).

It is not likely that the sediments designated and monitored by G&M as intermediate aquifer all connect up laterally into a single coherent hydraulic layer. This is particularly the case in the Melt Area due to the thin lenses and complex lithology, and to the liberal definition of the intermediate aquifer. A vertical hydraulic gradient exists regionally due to pumping in the lower aquifer (head decreasing with depth). Therefore one expects that water level in some wells—particularly those isolated from laterally extensive intermediate aquifer material—will tend to align with that of the lower aquifer. Well GM-14S may be such a well; its interval of aquifer material is thin and dissimilar to that of neighbors. Well GM-08S, which nearly exactly tracks the water level of lower aquifer well GM-08D, almost certainly is one. GM-12S, which G&M found to "breathe" in unison with lower aquifer pumping changes, is another.[45] Each of these wells has a depressed water level in comparison with other intermediate aquifer wells in its vicinity.

Because of the irregular distribution of laterally extensive intermediate aquifer material in the Melt Area, and the possibly misleading potentiometric dips where wells miss that aquifer, it is better to rely on larger scale trends in the potentiometric surface and to be skeptical of fine-grained features implied by single wells. That is the approach taken here.

Potentiometric contours and groundwater flow. I examined a selection of potentiometric maps with posted groundwater water elevation data, paying particular attention to groundwater passing beneath the Melt Area. I found that in the intermediate aquifer flow may proceed from northwest of the South Plant, southwest through the Melt Area, and offsite to the southwest.

I examined a small subset of the maps periodically submitted to the State by AK Steel. These maps were prepared by Arcadis G&M, provided to me by IEPA, and include water elevation surveys for the following dates: October 15-16, 2003, October 23, 2000, April 22, 2000, September 3, 1996, March 4, 1996, October 1, 1993, March 23, 1993, and July 20, 1992 (lacks lower aquifer figure). For the present review I chose to examine observed potentiometric data and not the AK Steel numerical model because reliable observations generally trump modeling assumptions and, for the most part, water elevation data should be reliable.

[45] GM-12S has been used by G&M to justify an extensive—and unlikely—cone of depression in the intermediate aquifer (e.g., G&M 10Nov92 Fig. 2). GM-12S was deduced by its air-venting behavior to be directly connected to the lower aquifer (G&M May 1989 Sect. 26, 59-61). It is inappropriate to use it to characterize the intermediate aquifer, especially over a wide area.

(1) I do have one serious concern about AK Steel water elevation data. Many of the observed water levels in the lower aquifer appear to have been collected from water supply wells active at the time of measurement. Due to "well losses"—which are energy losses created by nonlaminar flow within and immediately outside of a pumping well—the water level in a pumping well can be as much as tens of feet lower than that in very nearby aquifer material. Therefore it is often inaccurate to use within-pumping well data to characterize the potentiometric surface of an aquifer. From the reports I reviewed I cannot determine whether pumping well data has been used inappropriately, or if so then how many feet of excess drawdown was introduced into reported potentiometric surfaces. If excess drawdown is portrayed, then the inferred zones of capture may be too wide and may even obscure gaps in the ZOC. (Note: this concern applies only to the lower aquifer; no pumping wells are screened in the intermediate aquifer).

(2) There is a reasonable possibility that over a large area intermediate aquifer groundwater is not captured by lower aquifer production wells but rather flows from northwest of the South Plant, southwest through the Melt Area, and offsite to the southwest to west. I discuss this pathway in three segments: northwest of South Plant, within the Melt Area, and southwest to west of the Melt Area.

Northwest of South Plant. There is a large area over which no intermediate aquifer wells have been installed and therefore no water levels have been obtained. This area includes not only the entire South Plant (as discussed above) but also the area northwest of South Plant (the northeasternmost intermediate wells are GM-39D, GM-10S, and GM-14S). As discussed above, the existence of the intermediate aquifer within the South Plant remains unresolved; the same is true northwest of the South Plant where no wells or borings exist. What is certain is that there are no lower aquifer pumping wells in this area, and therefore a local potentiometric high may exist in the intermediate aquifer (if it exists) and propel groundwater from this area toward the Melt Area. In fact G&M and Arcadis G&M have consistently rendered a potentiometric high in this area implying flow broadly toward the southwest.[46] Absent any data this is a reasonable guess, and I adopt it for purposes of further discussion.

Beneath the Melt Area. Wells which G&M uses to characterize the intermediate aquifer beneath and immediately west of the Melt Area include GM-14S, 15S, 16S, 08S, 07S, and 05S, plus several wells in the COG pipeline spill area.

I begin by dismissing the data from the COG pipeline spill area wells. The intermediate aquifer as conceived by G&M near the COG pipeline spill and south of landfill SWMU 39 exhibits implausibly high water levels. Based on water levels from several dubiously classified wells, G&M potentiometric maps infer a very steep gradient within the intermediate aquifer between GM-29D, GM-46D, and the COG pipeline area. These contours are not credible.[47, 48, 49] Either the aquifer does not

[46] Based on the potentiometric surface maps I have reviewed, Arcadis may have recently recognized that available data do not justify inferring a potentiometric surface for the intermediate aquifer beneath and northwest of South Plant. The October 15-16, 2003 map does not include such contours, except for a limited area of dashed contours.

[47] Well GM-29D has much higher groundwater elevations than nearby GM-46D and GM-30D, typically 30 or more feet higher. However, the well is screened in an interval which contains 40

exist here or the wells are not deep enough to tap it (as suggested earlier); available borings do not resolve which.

Using data from the remaining wells and relying on larger scale trends as discussed above, groundwater flow appears to move from the Melt Area toward the southwest. For instance, in October 23, 2000 groundwater elevation declines from east to west from GM-15S (614.44) to GM-16S (611.22) to GM07S (607.65). In October 15-16, 2003 groundwater elevation declines irregularly and less convincingly from GM-15S (619.99) to GM-08S (616.55; see preceding comments on this well) to GM-07S (619.53).[50]

West to southwest of the Melt Area. The potentiometric surface west to southwest of the Melt Area remains unexplored. Indeed it is not known whether the intermediate aquifer even exists there or, if so, whether the potentiometric surface declines (promoting offsite migration) or rises toward the Great Miami River. As discussed earlier, it is unknown whether the intermediate aquifer continues beneath the COG pipeline spill area and beyond to the west-southwest through the area of G&M's inferred—but apparently unfounded—bedrock finger. On these matters I can only play devil's advocate and observe that if the unit exists, then it may conduct groundwater and any contaminants therein from the Melt Area toward the west to southwest.

Finally, on a more hopeful note, I observe that the two intermediate aquifer wells west to northwest of the Melt Area, GM-05S and GM-07S, are routinely sampled as part of the perimeter network and have not detected contamination. No intermediate aquifer sampling well exists west to southwest of the Melt Area

3.2 Coal Tar Decanter Sludge (K087) Storage Area at the Robin Hood Coal Pile

Hamper (2004 pg. 7) opines that my criticism of the closure of the Coal Tar Decanter Sludge (K087) Storage Area at the Robin Hood Coal Pile does not "give credit to AK Steel for implementing the bulk of the excavation activities associated with the RCRA

50% clay throughout and is just above bedrock. (There is a one foot lens of sand below the screen but within the filter pack directly on top of bedrock.) This is not reminiscent of intermediate aquifer materials monitored elsewhere; apparently the intermediate aquifer does not exist in any meaningful way at this boring location.

[48] In fact, given an identical condition at GM-47D on the east side of the Works, G&M potentiometric maps assign the well to the upper aquifer. This is done even though, like GM-29D, the cross section places the GM-47D screen at an intermediate aquifer elevation within clay and one foot of sand just above bedrock (G&M May 1989 Fig. 28).

[49] Wells near the COG pipeline spill have much higher groundwater elevations than surrounding intermediate wells such as GM-08S, GM-16S, and GM-46D. In some cases (DMW-1D, DMW-2D) the supposed intermediate aquifer wells are screened in a silty clay/clayey silt implying insulation from any nearby intermediate aquifer sediments (Dames & Moore 23Jul98 Figs. 3, 4). In other cases (GM-09S, DMW-4D) the screens are within sands or gravels, but the anomalous water levels belie any direct connection with the intermediate aquifer. Indeed, G&M also has been skeptical: in its reports GM-09S bounces back and forth between the upper and intermediate aquifers. (See earlier footnote).

[50] Arcadis G&M introduces oddly contorted contours in this vicinity which are hard to believe. For example consider the barbell shape of the 606 ft contour in the April 22, 2000 potentiometric diagram, or the long stem of the 605 ft contour in the October 23, 2000 diagram.

Closure more than ten years before the Ohio EPA even approved the Closure Plan and does not acknowledge the removal of more than 6,000 yards of tar-contaminated soils associated with former tar ponds in the coal pile area". On this basis he objects to my use of the term "gesture" to describe the closure and my statement that the closure "did nothing significant to improve widespread soil contamination from coal and coal derivatives".

Mr. Hamper's comments refer to two related excavation activities by Armco contractor ASCLP in 1990, only one of which occurred at the former K087 waste blending area. The layout of those various activities is shown in Figure 2. ASCLP removed and disposed of the coal base[51] from a 200 ft x 200 ft area at the east end of the former Robin Hood Coal Pile, including from the (now believed to be) 100 ft x 100 ft K087 waste blending area. During that excavation ASCLP encountered residual tar from former tar ponds that existed during the 1960s at the east end of the (then future) Robin Hood Coal Pile.[52] To "avoid complications associated with future closure activities" Armco elected to excavate 10-12 ft below grade over an L-shaped area which included part but not all of those former tar ponds, removing 6,360 yd^3 of tar-contaminated soil. This below-grade excavation did not include any part of the K087 waste blending area even though a portion of that area was underlain by a former tar pond and more of the area may have received spread residual tar when the ponds were converted. Moreover, it did not even include all of the former tar ponds footprint *outside* of the K087 waste blending area, but apparently only the part that Armco anticipated might complicate future closure of the K087 waste blending area.[53]

Therefore, to fairly augment my expert report I agree that AK Steel deserves credit for removing a portion of the tarry soils left over from ponds unrelated to K087 releases. In addition AK Steel deserves credit for removing the coal base in the 100 ft x 100 ft area that received the K087 wastes plus additional coal base in an area allegedly unrelated to the K087 releases. However, neither of these credits (or activities) pertains to the RCRA Clean Closure of the coal tar decanter sludge (K087) Storage Area at the former Robin Hood Coal Pile, which is the subject of my expert report comments. AK Steel is crystal clear that, as quoted in my expert report, "the objective of the closure…was to verify that K087 had not been released to the underlying soil or groundwater".[54] I stand by my conclusion that the closure failed to accomplish this objective and, for reasons spelled out in my report, constituted no more than a gesture to do so.

I also stand by my conclusion that the closure did nothing significant to improve widespread soil contamination from coal and coal derivatives. Mr. Hamper has taken my comment entirely out of context: it refers to the closure whose sole remedial action consisted of a small (27 yd^3) soil excavation. But to address the apparent substance of his concern, I agree that, tautologically, the excavation and removal of 6,360 yd^3 of tarry soils in 1990 reduced soil contamination at AK Steel. I also agree that removal of the

[51] The "coal base" at the Robin Hood Coal Pile consisted of "4 to 12 feet of raw coal…present as a base below the surface where [K087 hazardous waste] blending occurred" (Cox-Colvin Associates, May 19, 2000. Closure Certification Report, AK Steel Corporation, Middletown, Ohio, pg. 2).

[52] Prior to conversion of the area to coal storage in the early 1970s, much of the tar was removed and the residual tar was spread throughout the eastern end of the future Robin Hood Coal Pile.

[53] Facts in this paragraph rely on Cox-Colvin & Associates, Inc. (May 19, 2000, pp. 2, 3, Fig. 2).

[54] Cox-Colvin & Associates, Inc., May 19, 2000, pg. 1 of 16.

coal base beneath the K087 waste blending area in 1990 likely removed some residual K087 waste, thereby preventing its subsequent migration to underlying soils and groundwater. However, my concern remains that leaching of hazardous substances from post-1990 stored coal and Petcoke, as well as any pre-1990 wastes remaining in the soils after the excavation activities and inconclusive closure study (Chirlin 2003 pg. 3-27), pose a continuing release to soils and possibly to groundwater[55] at the former Robin Hood Coal Pile and adjacent storage areas. Soils beneath the former Robin Hood Coal pile are contaminated; the samples collected during the closure investigation demonstrated this. Only the high background concentrations adopted from other coal-pile impacted locations allowed these soils to remain unremedied. I address these matters further in Chirlin (2003 Sect. 3.2.1.4).

Finally, Hamper (2003 pg. 23) opines that the K087 sludge was too viscous "to significantly infiltrate into the coal" and that "the highly viscous nature would inhibit migration through the 12 to 14 ft thick layer of coal reported by PRC (1992) to the buried soil layer". However, Hamper (2003) does not address the more fundemental question of

FOIA Exempt; Prepared in Anticipation of Litigation; Attorney/Client Privilege

Technical Memorandum

Date: 9/08/04

Subject: Derivation of Sediment Cleanup Goal for Dick's Creek, Reach 2

From: Bhooma Sundar, Toxicologist
Corrective Action Section, ECAB, WPTD

To: Robert Guenther
Associate Regional Counsel, ORC

This memorandum is provided in response to the conference call on 8/20/04 between DOJ and the EPA Region 5 RCRA AK Steel case management team. I was asked to develop a Sediment Cleanup Goal for protection of human health in a stepwise fashion. This included calculating a biota/sediment accumulation factor (BSAF), following EPA recommended risk-based methods for developing screening values for total PCB in fish, and then developing a cleanup goal for Total PCBs in sediment that provides a direct link between fish consumption rate and risk levels. The data for the derivation of Sediment Cleanup Goals was obtained from selected tables in the human health risk assessment (DeGrandchamp, 2003) and ecological risk assessment (Barron, 2003) reports prepared for EPA for the litigation.

Summary

The following Tables identify sediment cleanup goals for cancer risks ranging from 1 x 10 –6 (most protective) to 1 x 10 –4 (least protective) for both Total PCB Aroclors and Totoal PCB Congener. Data used for the calculations was collected by EPA in July 2002 (fish tissue) and March 2003 (sediments, TOC).

Cleanup Goal Summary for Total PCB Aroclors in sediments (mg/kg) for Recreational fishers				
	Per EPA- recommended SV[1]		Per HHRA- Dick's Creek[2]	
	BSAF based on		BSAF based on	
Cancer risk	Reach Average [3]	Individual Fish [4]	Reach Average	Individual Fish
1 X 10-6	0.005	0.0004	0.027	0.002
1 X 10-5	0.050	0.004	0.27	0.021
1 X 10-4	0.5	0.04	2.7	0.21

Cleanup Goal Summary for Total PCB Congeners in sediments (mg/kg) for Recreational fishers				
	Per EPA- recommended SV [1]		Per HHRA- Dick's Creek [2]	
	BSAF based on		BSAF based on	
Cancer risk	Reach Average[3]	Individual Fish[4]	Reach Average	Individual Fish
1 X 10-6	0.0027	0.0001	0.015	0.0009
1 X 10-5	0.027	0.0016	0.15	0.0093
1 X 10-4	0.27	0.016	1.5	0.093

Foot notes:

1. A screening value (SV) 0.002 mg/kg of PCB in the fish as recommended by EPA Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Vol 1.

2. Screening value of 0.011 mg/kg of PCB in the fish based on exposure assumptions used for fish ingestion by adult recreational receptors in the Human Health Risk Assessment for Dick's Creek, DeGrandchamp, for EPA, 2003.

3. BSAF calculated based on averaging the sediment PCB concentration and Total Organic carbon content ranging from 0.3 to 2.81 river mile. Also, Fish lipid fraction and fish total PCB concentration were averaged for fish caught between 1.7 and 2.81 river mile. (The calculated BSAF for PCB Aroclors and PCB Congeners is 0.178 and 0.323 respectively)

4. BSAF was calculated for individual fish caught in different locations within Reach 2. Based on the data distribution, either an MVUE or t - test was performed to obtain 95%UCL of the mean. (The calculated BSAF for PCB Aroclors and PCB Congeners is 2.27 and 5.27 respectively)

Discussion

Region 5 has developed a methodology to calculate Sediment Cleanup Goal (SCG) using lipid and TOC (Total Organic Carbon) normalized BSAF. The following steps are involved in developing SCG.

1. Set acceptable contaminant level in fish (SV)
2. Determine total organic carbon (TOC) in sediment
3. Determine lipid content of fish
4. Calculate BSAF
5. Calculate the Sediment Cleanup Goal (SCG)

Step 1: Set Acceptable Contaminant level in fish
The 2003 Human health risk assessment was the basis for selecting appropriate PCB contamination level in fish. Dr.Richard DeGrandChamp suggested during the conference call that a EPA recommended screening value of 0.02 ppm in fish tissue be used in the calculation of SCG. This screening value (SV) relates to a risk level corresponding to one excess case of cancer per 100,000 individuals exposed over a 70- yr lifetime.

The following equation was used in calculating the EPA recommended screening criteria

[(1x10-5/2 kg- d/mg) * 70 kg]/0.017kg/d = 0.02 mg/kg

The above equation however, does not take in to account the other exposure assumptions such as exposure frequency, exposure duration and fraction of fish PCB ingested in calculating average daily intake. To compensate this deficiency, a site specific screening value for total PCB in fish was calculated using exposure assumptions used in HHRA for Dick's Creek involving adult recreational receptor scenario. See foot note 1 in summary table 1.

Exposure = CR*EF*ED*CF*F*(1/BW)*(1/ATc)

As per the parameters used in the calculation based on 50% ingested fish contaminant and 18 g/day of fish meal, the screening criteria was calculated to be 0. 11 ppm relating to a risk level corresponding to one excess case of cancer per 100,000 individuals exposed over a 70- yr lifetime. See foot note 2 in summary table 1.

Step 2: Determine TOC in Sediments

Sediment ID	River mile	TOC-fraction
S03	1.63	0.021
S04	1.7	0.013
S05	1.87	0.006
S06	2	0.005
S07	2.45	0.009
S09	2.64	0.005
S10	0.01	0.006
S11	0.35	0.014
S12	2.76	0.008
S13	2.81	0.008

The W test conducted to study the data distribution showed a lognormal distribution. Hence Land's method was used to obtain 95% UCL of the arithmetic mean. Thus the TOC in sediment was determined to be 1.3%.

Step 3: Determine lipid content of fish

Fish ID	Lipid Fraction
F01	0.033
F02	NC
F03	0.01
F04	0.02
F05	0.025
F06	0.018
F07	NC
F08	0.017
F09	0.013
F10	0.03

The W test conducted to study the data distribution showed a lognormal distribution. Hence Land's method was used to obtain 95% UCL of the arithmetic mean. Thus the ~~TOC~~ Lipid content in sediment was determined to be 2.9 %.

Step 4: Calculate BSAF

BSAF is defined as " the ratio of a substance's lipid-normalized concentration in tissue of an aquatic organism to its organic carbon normalized concentration in surface sediment, in situations where the ratio does not change substantially over time, both the organism and its food are exposed and the surface sediment is representative of average surface sediment in the vicinity of the organism."

PCB levels and the respective BSAF of individual fish

Fish Type	River mile	Lipid Fraction	Total PCB Aroclors mg/kg ww	Total PCB Congeners mg/kg ww	BSAF Total PCB Aroclors	BSAF Total PCB Congeners
Common Carp	2.8	0.033	4.85	18.5	0.22698	1.7939
Smallmouth Bass	2.8	NC	1.4	4.21	NC	NC
Channel Catfish	2.8	0.01	0.77	3.22	0.118919	1.0304
Channel Catfish	2.5	0.02	1.07	3.79	0.024196	0.044882
Channel Catfish	2.5	0.025	1.13	2.43	0.020442	0.023021
Common Carp	2.5	0.018	4.22	11.1	0.10603	0.14603
Smallmouth Bass	1.7	NC	0.83	4.16	NC	NC
Flathead Catfish	1.7	0.017	2.75	10.1	3.285846	6.4362
Channel Catfish	1.7	0.013	4.42	11.1	6.90625	9.25
Common Carp	1.7	0.03	4.8	12.9	3.25	4.65833

$BSAF = (Cb*f_{OC})/(Cs*f_{lipid})$ where

BSAF = Biota/Sediment Accumulation factor (g carbon/ g lipid)
Cb = Organism concentration at steady state (mg/kg wet wt)
f_{lipid} = fractional lipid contents of the tissues (g/g wet wt)
Cs = Contaminant concentration in the sediments (mg/Kg dry wt)
f_{OC} = fractional organic carbon contents of the sediments (g/g dry wt)

The above table summarizes the PCB level, lipid fraction and the respective BSAF in individual fishes caught with in the reach. Based on the reach length ranging from 0.3 to 2.8 river mile, BSAF was calculated by averaging the concentration of aroclor based PCBs and Congener based PCBs in the sediment. The W test conducted to study the data distribution showed a lognormal distribution. Hence Land's method was used to obtain 95% UCL of the arithmetic mean. The 95% UCL was much higher than the maximum value found in the case of aroclor based PCBs and Congener based PCBs. As per the regional statiscian's recommendation, MVUE of the mean was calculated, which is 6.69mg/kg and 11.38 mg/kg respectively for aroclor based PCBs and Congener based PCBs. Similarly, MVUE was calculated for log normal distributed Fish total PCBs. The mean values were determined to be 2.66 mg/kg and 8.2 mg/kg respectively for aroclor based PCBs and Congener based PCBs.

Thus based on a reach average,

$BSAF_{PCB\text{-}Arocolors} = (2.66\ mg/kg * 0.013)/(6.69\ mg/kg * 0.029) = 0.178$

$BSAF_{PCB\text{-}Congeners} = (8.2\ mg/kg * 0.013)/(11.38\ mg/kg * 0.029) = 0.323$

Based on BSAF calculated from individual fish obtained with in the entire segment of reach, the calculated average BSAF turns out be 2.27 for $BSAF_{PCB\text{-}Arocolors}$ and 5.27 for $BSAF_{PCB\text{-}Congeners}$.

Step 5 : Calculate Sediment Cleanup Goal (SCG)

The sediment cleanup goal was calculated as below

SCG = (Cb*f_{OC})/(BSAF*f_{lipid}) where

SCG = Contaminant concentration in the sediments (mg/Kg dry wt)
Cb = Organism concentration at steady state (mg/kg wet wt)
f_{OC} = fractional organic carbon contents of the sediments (g/g dry wt)
BSAF = Biota/Sediment Accumulation factor (g carbon/ g lipid)
f_{lipid} = fractional lipid contents of the tissues (g/g wet wt)

Cleanup Goal Summary for PCB- Aroclors in sediments (mg/kg) for Recreational fishers				
	Per EPA- recommended SV[1] BSAF based on		Per HHRA- Dick's Creek[2] BSAF based on	
Cancer risk	Reach Average [3]	Individual Fish [4]	Reach Average	Individual Fish
1 X 10-6	0.005	0.0004	0.027	0.002
1 X 10-5	0.050	0.004	0.27	0.021
1 X 10-4	0.5	0.04	2.7	0.21

Cleanup Goal Summary for PCBCongeners in sediments (mg/kg) for Recreational fishers				
	Per EPA- recommended SV [1] BSAF based on		Per HHRA- Dick's Creek [2] BSAF based on	
Cancer risk	Reach Average[3]	Individual Fish[4]	Reach Average	Individual Fish
1 X 10-6	0.0027	0.0001	0.015	0.0009
1 X 10-5	0.027	0.0016	0.15	0.0093
1 X 10-4	0.27	0.016	1.5	0.093

Foot notes:

1. A screening value (SV) 0.002 mg/kg of PCB in the fish as recommended by Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Vol 1.

2. Screening value of 0.011 mg/Kg of PCB in the fish based on exposure assumptions used for fish ingestion by adult recreational receptor in Human health risk assessment for Dick's Creek, EPA 2003. Fish advisory goal for PCB in fish tissue is 0.050 mg/kg.

3. BSAF calculated based on averaging the sediment PCB concentration and Total Organic carbon content ranging from 0.3 to 2.81 river mile. Also, Fish lipid fraction and fish total PCB concentration were averaged for fish caught between 1.7 and 2.81 river mile. (The calculated BSAF for PCB Aroclors and PCB Congeners is 0.178 and 0.323 respectively)

4. BSAF was calculated for individual fish caught in different locations with in reach 2. Based on the data distribution, either an MVUE or t - test was performed to obtain 95%UCL of the mean. (The calculated BSAF for PCB Aroclors and PCB Congeners is 2.27 and 5.27 respectively).

How the projected numbers in the summary column compare with other clean up sites:

The SCG was calculated similar to the approach for human health SCGs used by State of Washington for Hylebos Waterway, Commencement Bay, Near Shore/Tide Flats superfund site. 0.5 ppm in sediments has been selected as an appropriate human health clean up goal, based on the consumption of bass under the reasonable maximum exposure conditions which equals 1 in ten thousand risk. The corresponding BSAF based on which the SCG was derived is 4.54 with a total lipid content of 0.715% and a total organic carbon content 5.3%.

Uncertainty:

In the absence of information such as fish life-history and home range and the contaminant of concern (COC) bioconcentration with fish size or age, it is difficult to accurately interpret BSAF results. Further, it is uncertain that the fish were collected at the site representative of long-term, steady- state bioaccumulation. In light of the above uncertainties regarding the BSAF calculation, it is possible that the projected sediment cleanup goal may be slightly underestimating or overestimating risk. However, chlorinated chemicals such as PCBs and PCDs having large Kows and low metabolism rates tend to provide more reliable BSAFs than chemicals like PAHs which have higher rates of metabolism.

Donald F. Hayes, Ph.D., P.E.
1580 Altair Circle • Sandy, UT 84093

DRAFT

JOINT PROSECUTION PRIVILEGED

August 30, 2004

Mr. Robert Darnell
U.S. Department of Justice
Environment and Natural Resources Division
Environmental Enforcement Section
Room 12082, 1425 New York Ave., NW
P.0. Box 7611
Washington, DC 20044-7611

Re: United States et al. v. AK Steel Corporation, DJ Number 90-5-2-1-2189

Mr. Darnell,

This letter summarizes my findings on the practicability of dredging PCB-contaminated sediments from Reach 2 of Dick's Creek near Middletown, Ohio (Figure 1). I have taken Reach 2 to extend from the general vicinity of Yankee Road (upstream) to the general vicinity of Main Street (downstream). Figure 1 shows this reach of Dick's Creek. This letter serves as my primary work product under Contract/Purchase Order Number 4WENR0107050.

Basis for Evaluation

I have reviewed available site documents, obtained general information on relevant equipment that might be used, and visited the Dick's Creek site on July 29, 2004 with Mr. Gary Cygan, EPA Region 5. These findings result from these information gathering efforts combined with my knowledge of dredging equipment, environmental dredging operations, and contaminated sediment management.

Specific documents reviewed include:

- Mikulka, Michael J., "Field & Laboratory Data Report: Physical and Chemical Characterization of Dicks Creek and Associated Flood Plain, Middletown, OH," US Environmental Protection Agency, July 2003.

- A variety of site maps and photographs

Evaluation of Dredging Alternatives

Mechanical Dredging. The dense vegetation and large trees that line Dick's Creek along most of this reach make land-based mechanical sediment removal difficult to accomplish without significant clearing. Not only is access limited by the vegetation, the over story may limit removal to equipment with reach distances less than the creek width; i.e. the equipment would

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have to work within the banks of the creek. Further, there is insufficient water depth to float filled barges with mechanically dredged sediment, although this may be solvable by temporary structures to increase the water depth.

Hydraulic Dredging. Small hydraulic dredges, such as shown in Figure 2, are available that can work within the confines of Dick's Creek. The model shown is a horizontal auger dredge, although similar dredges are available with basket-style cutterheads. With the exception of riffles[1], existing water depths in most areas provide the necessary 25-inch draft; dredging may increase the depth in any places not currently adequate.

Hydraulic dredging adds large volumes of carrier water in order to pump the sediment in a slurry mixture; the slurry mixture will be pumped at near 10% solids[2], while in situ sediments are likely 60 – 80% solids. Managing this dilute sediment stream is the primary problem associated with hydraulic dredging because of the large flow rate generated by the dredge pump. The traditional approach is to pump the slurry into a confined disposal facility (CDF) to dampen fluctuations in flow and separate the solids from the carrier water. A temporary CDF could be sited on some of the adjacent farmland and slurry pumped to it from the entire reach. If necessary, decanted sediment can be excavated from the CDF and moved to an appropriate landfill after dredging is complete. In order to accelerate dewatering, the CDF should be constructed to keep the sediment thickness to less than 3 feet. A 5-acre parcel should be adequate to allow for staging, access, and a sufficiently large storage area.

Effluent from a CDF would need to meet 401 WQ certification requirements established by the State of Ohio. Methods for testing sediments and predicting effluent quality from CDFs have been developed by the US Army Corps of Engineers. For the purposes of this report, it is assumed that a carbon-based wastewater treatment plant will be required to treat the CDF effluent to meet Ohio water quality requirements. Portable, carbon-based treatment plants are readily available and have been used on similar projects.

An alternative to CDF disposal would be to pump the slurry directly into bags made from porous geotextile. The porous geotextile cloth serves to retain sediment particles while allowing the carrier water to flow through. Geotextile bags should reduce the land area necessary to manage the pumped sediments and can be transported immediately to an appropriate landfill after filling. This process has been successfully accomplished at a number of sites and Dr. Jack Fowler of Geotec Associates[3] indicated that they had been able to meet paint filter requirements for landfill disposal. He also indicated that site characteristics similar to Dick's Creek seem to be conducive to the use of geotextile bags. Additional general information about the use of geotextile bags and tubes is available at www.geotec.biz.

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[1]A small hydraulic dredge with a front-mounted winch may be able to pull itself through the riffles in Dick's Creek without having to deepen the area and remove sediments unnecessarily.

[2]Some technologies have been reported to pump sediment slurries at substantially higher concentrations, possibly as high as 30% solids. However, the purpose of this report is to evaluate the feasibility of dredging, not provide an optimal design. Thus, the remainder of report assumes a 10% solids slurry.)

[3]Geotec Associates, 5000 Lowry Road, Vicksburg, MS 39180, 601/636-5475.

Much like CDF discharge, the primary concern with hydraulic dredging and pumping directly into geotextile bags is managing the decant water. Dr. Fowler indicated that a test has been developed to estimate the quality of the discharge water; these tests should provide sufficient information to evaluate various discharge water management alternatives. I anticipate that the decant water would require treatment prior to discharge back to Dick's Creek similar to CDF discharge.

Duration and Costs

A 6-inch dredge as described above should be capable of moving about 20 cy/hr of sediment. Assuming 10,000 cy for the total project, that production rate corresponds to 500 working hours or about 3 months. Encountering significant problems and downtime may extend that working period.

Costs for the dredging operation as described should be approximately that for a typical dredging operation with additional costs for managing the discharge water, sediment transport and disposal, and purchasing the geotextile bags if those are used. Dredging costs of about $10/cy are reasonable for this scale of project; this includes pumping the slurry to a nearby confined disposal facility (CDF). For similar projects, the cost for constructing a CDF including land acquisition, construction, and placement should be about $30/cy. A package treatment plant would likely be necessary to treat the CDF effluent to a sufficient level to allow discharge directly back into Dick's Creek. The dredge will produce about 1.5 MGD of total flow which can be dampened by the CDF to about 0.5 MGD assuming 8 hours/day of dredge operation and 24 hours of CDF discharge. Based upon discussions with TIGG Corporation[4], equipment rental and operation of an adequate package water treatment system should cost about $100,000 for a 3 month operation (8 hrs, 5 days/week), or about $10/cy. Thus, the total cost of dredging, temporary storage, and effluent treatment is estimated to be $50/cy.

I assume that the sediment would be removed from the CDF for final disposal and acceptable for disposal in a sanitary landfill. In that case, we must add the cost for sediment removal from the CDF, transportation to a nearby landfill, and the tipping fee for the landfill. Since the Rumpke Landfill is nearby, $10/cy should be adequate for removal and transportation. Mr. Garry Riddle with the Rumpke Landfill indicated that the tipping fee for the sediment would likely be about $30/ton including $6/ton for local fees; one ton of in situ sediment occupies about 1 cy. An additional $10/cy is assumed to remove the CDF and restore the land to its original condition.

Thus, I estimate that 10,000 cy of sediment from Dick's Creek can be dredged and managed for about $100/cy, or about $1 million. Using geotextile bags could be more expensive, but their convenience may warrant the additional costs.

[4]600 Old Pond Road, Bridgeville, PA, 1-800-825-0011, Mr. Jim Riley of TIGG provided the basis for this estimate by assuming a 0.5 MGD flow for 24 hours/day with 100 mg/L of influent solids.

Findings

Based upon the available information, a site visit to Dick's Creek, and my experience in dredging, It is my opinion that PCB contaminated sediments in Reach 2 of Dick's Creek near Middletown, OH can be removed using readily available dredging equipment without significant disturbance of existing vegetation.

Sincerely,

Donald F. Hayes, Ph.D., P.E.

Figure 1. Map of Dick's Creek, Reach 2, which is about 1 mile in length.

MUD CAT™ AUGER MODEL SP-810	
Length (O.A.)	28 ft 6 in (8.68 m)
Width (O.A.)	8 ft 0 in (2.44 m)
Height (O.A.)	9 ft (2.85 m)
Weight	15,500 lbs (7030 kg) dry
Draft	25 in (0.64 m)
Fuel Capacity	180 gallons (680 liters)
Cut	8 ft (2.44 m) wide x 18 in (.457 m) maximum depth
Operating Depth	10.5 ft (3.2 m) Maximum
Suction Diameter	6 in (152 mm) (8 in [203 mm] available as option)
Discharge Diameter	6 in (152 mm)
Nominal Pump Performance	1000 GPM (3785 liters/min) against 100 ft (30.5 m) Head (water) at 1600 RPM

Figure 2. Photograph of Mudcat SP-810 and specifications from www.Ellicott.com.

Donald F. Hayes, Ph.D., P.E.
1580 Altair Circle • Sandy, UT 840093

DRAFT

August 25, 2004

Mr. Robert Darnell
U.S. Department of Justice
Environment and Natural Resources Division
Environmental Enforcement Section
Room 12082, 1425 New York Ave., NW
P.0. Box. 7611
Washington, DC 20044-7611

Re: United States et al. v. AK Steel Corporation, DJ Number 90-5-2-1-2189

Mr. Darnell,

This letter summarizes my findings on the practicability of dredging PCB-contaminated sediments from Reach 2 of Dick's Creek near Middletown, Ohio (Figure 1). I have taken Reach 2 to extend from the general vicinity of Yankee Road (upstream) to the general vicinity of Main Street (downstream). Figure 1 shows this reach of Dick's Creek. This letter serves as my primary work product under Contract/Purchase Order Number 4WENR0107050.

Basis for Evaluation

I have reviewed available site documents, obtained general information on relevant equipment that might be used, and visited the Dick's Creek site on July 29, 2004 with Mr. Gary Cygan, EPA Region 5. These findings result from these information gathering efforts combined with my knowledge of dredging equipment, environmental dredging operations, and contaminated sediment management.

Specific documents reviewed include:

- Mikulka, Michael J., "Field & Laboratory Data Report: Physical and Chemical Characterization of Dicks Creek and Associated Flood Plain, Middletown, OH," US Environmental Protection Agency, July 2003.
- A variety of site maps and photographs

Evaluation of Dredging Alternatives

Mechanical Dredging. The dense vegetation and large trees that line Dick's Creek along most of this reach make land-based mechanical sediment removal difficult to accomplish without significant clearing. Not only is access limited by the vegetation, the over story may limit removal to equipment with reach distances less than the creek width; i.e. the equipment would

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have to work within the banks of the creek. Further, there is insufficient water depth to float filled barges with mechanically dredged sediment, although this may be solvable by temporary structures to increase the water depth.

Hydraulic Dredging. Small hydraulic dredges, such as shown in Figure 2, are available that can work within the confines of Dick's Creek. The model shown is a horizontal auger dredge, although similar dredges are available with basket-style cutterheads. With the exception of riffles, existing water depths provide the necessary 25-inch draft; dredging will increase the depth in any places not currently adequate.

Hydraulic dredging adds large volumes of carrier water in order to pump the sediment in a slurry mixture; the slurry mixture will be pumped at near 10% solids, while in situ sediments are likely 60 – 80% solids. Managing this dilute sediment stream is the primary problem associated with hydraulic dredging because of the large flow rate generated by the dredge pump. The traditional approach is to pump the slurry into a confined disposal facility (CDF) to dampen fluctuations in flow and separate the solids from the carrier water. A temporary CDF could be sited on some of the adjacent farmland and slurry pumped to it from the entire reach. If necessary, decanted sediment can be excavated from the CDF and moved to an appropriate landfill after dredging is complete. In order to accelerate dewatering, the CDF should be constructed to keep the sediment thickness to less than 3 feet. A 5-acre parcel should be adequate to allow for staging, access, and a sufficiently large storage area.

Effluent from a CDF would need to meet 401 WQ certification requirements imposed by the State of Ohio or discharge to a nearby wastewater treatment plant. Although a wastewater treatment facility exists just downstream of Reach 2, I have not checked to see if they can handle an additional flow of 1.5 MGD or if the treatment processes are capable of sufficient PCB removal to accept the CDF effluent and still meet their NPDES permit limits. Methods for testing sediments and predicting effluent quality from CDFs has been developed by the US Army Corps of Engineers.

An alternative to CDF disposal, however, is to pump the slurry directly into bags made from porous geotextile. The porous geotextile cloth serves to retain sediment particles while allowing the carrier water to flow through. Geotextile bags should reduce the land area necessary to manage the pumped sediments and can be transported immediately to an appropriate landfill after filling. This process has been successfully accomplished at a number of sites and Dr. Jack Fowler of Geotec Associates[1] indicated that they had been able to meet paint filter requirements for landfill disposal. He also indicated that site characteristics similar to Dick's Creek seem to be conducive to the use of geotextile bags. Additional general information about the use of geotextile bags and tubes is available at www.geotec.biz.

Much like CDF discharge, the primary concern with hydraulic dredging and pumping directly into geotextile bags is managing the discharge water. Dr. Fowler indicated that a test has been developed to estimate the quality of the discharge water; these tests should provide sufficient information to evaluate various discharge water management alternatives. One alternative would be to pump the discharge water to the local wastewater treatment facility; the same caveats

[1] Geotec Associates, 5000 Lowry Road, Vicksburg, MS 39180, 601/636-5475.

mentioned previously for a CDF also apply to this alternative. Depending upon the testing results, discharging directly back to Dick's Creek may be a consideration. While it is unlikely that the immediate discharge would meet 401 WQ Certification requirements, it might be possible to define the compliance point further downstream in Dick's Creek and construct some pools in the creek to increase retention time and improve water quality before reaching the compliance point. For example, the bridge at Jackson Street could be used as such a structure and other temporary retention structures could be constructed downstream from sheetpile.

Duration and Costs

A 6-inch dredge as described above should be capable of moving about 20 cy/hr of sediment. Assuming 10,000 cy for the total project, that production rate corresponds to 500 working hours or about 3 months. Encountering significant problems and downtime may extend that working period.

Costs for the dredging operation as described should be approximately that for a typical dredging operation with additional costs for managing the discharge water, sediment transport and disposal, and purchasing the geotextile bags if those are used. Dredging costs of about \$10/cy are reasonable for this scale of project; this includes pumping the slurry to a nearby confined disposal facility (CDF). For similar projects, the cost for constructing a CDF including land acquisition, construction, and removal should be about \$30/cy based. A package treatment plant would likely be necessary to treat the CDF effluent to a sufficient level to allow discharge directly back into Dick's Creek. The dredge will produce about 1.5 MGD of total flow which can be dampened by the CDF to about 0.5 MGD assuming 8 hours/day of dredge operation and 24 hours of CDF discharge. Based upon discussions with TIGG Corporation[2], equipment rental and operation of an adequate package water treatment system should cost about \$100,000 for a 3 month operation, or about \$10/cy. Thus, the total cost of dredging, temporary storage, and effluent treatment is estimated to be \$50/cy.

I assume that the sediment would be removed from the CDF for final disposal and acceptable for disposal in a sanitary landfill. In that case, we must add the cost for sediment removal from the CDF, transportation to a nearby landfill, and the tipping fee for the landfill. Since the Rumpkey Sanitary Landfill is nearby, \$10/cy should be adequate for removal and transportation. Mr. Garry Riddle with the Rumpkey Sanitary Landfill indicated that the tipping fee for the sediment would likely be about \$30/ton including \$6/ton for local fees; one ton of in situ sediment occupies about 1 cy. An additional \$10/cy is assumed to remove the CDF and restore the land to its original condition.

Thus, I estimate that 10,000 cy of sediment from Dick's Creek can be dredged and managed for about \$100/cy, or about \$1 million. Using geotextile bags could be more expense, but may be selected for convenience.

[2] 600 Old Pond Road, Bridgeville, PA, 1-800-825-0011, Mr. Jim Riley of TIGG provided the basis for this estimate by assuming a 0.5 MGD flow for 24 hours/day with 100 mg/L of influent solids.

Findings

Based upon the available information, a site visit to Dick's Creek, and my experience in dredging, I firmly believe that PCB contaminated sediments in Reach 2 of Dick's Creek near Middletown, OH can be removed using readily available dredging equipment. These findings should not be construed as a recommendation for dredging of Dick's Creek as my evaluation does not include consideration of any other remedial option.

Sincerely,

Donald F. Hayes, Ph.D., P.E.

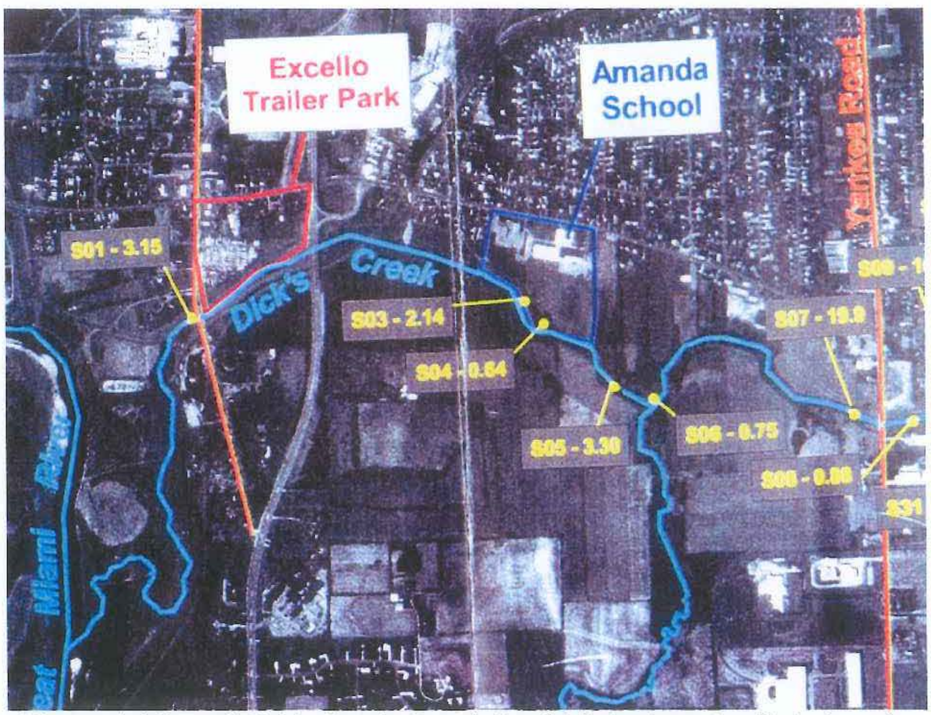

Figure 1. Map of Dick's Creek, Reach 2, which is about 1 mile in length.

MUD CAT™ AUGER MODEL SP-810	
Length (O.A.)	28 ft 6 in (8.68 m)
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Figure 2. Photograph of Mudcat SP-810 and specifications from www.Ellicott.com.

August 24, 2004

Gary and Mike,

In order to calculate the BSAF, we need a table for sediment and fish data that meets the following criteria.

1. FISH data collected either by OHIO EPA (per Mace, preferably from 2000 or 2002), or Arcadis or USEPA fish data **Gary can get you that if don't already have it.**

2. *Co located* SEDIMENT samples - preferably within one to two miles of fish collection points. Select the sediment samples based on the year of the fish collection, or from up to two years prior to the fish sample event. **You can get that from the sediment report; there is a CD in the back of it with all the data.**

3. Sediment data should include total PCB concentrations along with total organic carbon content. **The CD has that for both Aroclors and PCB congeners.**

4. Fish data must have total PCB concentration along with lipid fraction. **We have that; see #2.**

5. We are looking for at least 7-8 fish samples with representative sediment locations preferably with in Reach 2. **See data from #2**

Assumptions for BSAF:

1. System is in steady-state i.e., no new/ongoing PCB sources and hydro/thermodynamics do not influence flux **OK**

2. Fish are resident and sediment samples come from their home range **OK, probably true for panfish at least**

then,

BSAF-based clean-up level is approximate and uncertain but not based on NUTHIN!

Attorney-Client Privilege, Prepared for Settlement Purposes Only

To: Robert Darnell, Trial Attorney, U.S. Department of Justice

Rob, this memo addresses another area which AK has addressed in writing (see letter dated August 11, 2004, from Tim Barber, Arcadis, to Mary Gade, Sonnenschein Nath & Rosenthal LLP), but we have not responded in writing. Here is a draft response, subject to input by others. I would recommend input by Mace Barron as well as OEPA biological monitoring staff.

Biological Monitoring to Assess Effectiveness of Sediment Treatment: AK Proposal

While the government proposals for settlement did not address biological monitoring, AK did propose such methods as part of its proposal to conduct in-situ remediation in lieu of dredging for Reach 2 of Dicks creek. AK proposed the methods for assessing the effectiveness of proposed sediment treatment measures through biological monitoring described below.

Two sediment remediation techniques have been proposed for Dick's Creek: (1) sediment removal using hydraulic dredging in Reach 1 of the creek, and (2) stabilization of PCBs by amendment with activated carbon in Reach 2 (the area between the USGS gauging station downstream of Yankee Road and just downstream of Main Street. Because PCBs would remain in the sediment in the area treated with activated carbon, AK proposed biological monitoring to assess whether PCB bioaccumulation declines in this area as expected. Several options were available for monitoring bioaccumulation, including laboratory assays, placement of caged organisms, and sampling of native biota. AK selected analyses of native fish tissue, because this approach provides a direct measure of conditions occurring in the field.

Biological monitoring will be conducted according to the following general chronology:

1. Establish pre-dredging baseline conditions. While extensive fish tissue data are available from Dick's Creek, these data were collected for risk assessment purposes. In order to statistically evaluate trends over time, it will be useful to sample a smaller number of species, with a larger number of samples per species. Additionally, the existing data indicate a decline in PCB concentrations over the years 1998 – 2002, and PCB concentrations have likely continued to decline since then. Therefore, fish tissue sampling will initially be conducted immediately prior to dredging activities.

2. Conduct sediment removal measures in the channelized area.

3. Establish post-dredging baseline conditions. Concentrations of PCBs in fish tissue will again be determined after the completion of dredging and before the initiation of activated carbon treatment measures. This is important, because dredging has been observed to cause a temporary spike in chemical bioavailability and bioaccumulation (e.g., Weston et al. 2002; Baumann 1998). Although dredging and activated carbon treatment are not proposed for the same area, upstream dredging could affect PCB bioaccumulation in the proposed activated carbon treatment area.

4. Conduct sediment treatment in the non-channelized area of interest.

5. Conduct post-treatment monitoring. Post-treatment monitoring will be initiated approximately one year after sediment treatment is completed. This will allow time for PCBs to be partially depurated from previously exposed fish and for PCB adsorption to the activated carbon to equilibrate (Buckman et al. 2004; Luthy 2004; Werner et al. 2004). Sampling will be repeated annually until PCB concentrations in fish stabilize (i.e., no statistically significant decreases are detectable over three years).

The monitoring program will focus on two fish species: common carp (*Cyprinus carpio*) and longear sunfish (*Lepomis megalotis*). Carp will be sampled as fillets to represent tissue potentially consumed by humans, and longear sunfish will be sampled as whole fish to represent tissue potentially consumed by wildlife. Carp are selected because they are one of only two large fish species that are abundant enough in Dick's Creek to support a monitoring program. The other large fish species, golden redhorse (*Moxostoma erythrurum*), is highly migratory and therefore unsuitable for long-term monitoring (Trautman 1981). However, it is important to note that carp are not highly valued as game fish and also tend to accumulate higher PCB concentrations than other fish species, due to their high lipid content. Longear sunfish, a small to medium-sized species, are abundant in Dick's Creek and have been consistently collected during past tissue sampling efforts.

During each sampling event, eight composite samples of each species will be collected from the area of interest (Dick's Creek between Yankee Road and Main Street). Fish will be collected throughout the area except at the extreme ends of the reach, to lessen the capture of fish that may be exposed to PCBs outside the area of interest. Each sample will consist of at least three individual fish collected near one another. The location of specific sampling zones within the area of interest will depend on fish abundance and will be recorded in the field. Sampling will be conducted in autumn, because fish typically contain higher lipid concentrations and thus higher PCB levels at this time of year.

Fish tissue sampling will be conducted in accordance with Ohio EPA (1994) guidance. The length and weight of each fish will be recorded, and lipid content will be analyzed. These factors may be useful in explaining variability in PCB concentrations among samples. Fish age can also be a key factor; for example, Baumann (1998) used age determinations to show that fish exposed to polycyclic aromatic hydrocarbons during dredging experienced an increase in tumors, whereas tumors were much lower in fish born after the completion of dredging. Therefore, age will be determined in longear sunfish. However, carp age cannot be reliably determined. To limit potential confounding effects of age, carp sampling will target a limited size range, specifically fish ranging from 15 to 20 inches in length. Based on a quantitative fish survey (EA 2001), carp of this intermediate size class were prevalent in the area of interest. Concentrations of PCBs in fish tissue will be analyzed using pressurized fluid extraction followed by PCB homologue analysis with USEPA Method 680.

Laboratory tests have shown that the addition of activated carbon to contaminated sediment can reduce the bioaccumulation of organic compounds by 70-90% (Luthy 2003; 2004; Werner et al. 2004; Zimmerman et al. 2004). The greatest reductions in bioaccumulation were associated with the longest equilibration times. Thus, up to an order of magnitude reduction in fish tissue concentrations may be achievable using this technology. However, in a field application, it will be more challenging to mix the activated carbon with the sediment, as compared to a laboratory setting. Therefore, a decrease in fish tissue PCB concentrations of 70% will be considered successful.

USEPA Comments on AK Proposal on Biological Monitoring

USEPA concurs that biological monitoring should be conducted to assess effectiveness of remedial measures. OEPA regularly conducts such monitoring in state watersheds on an approximate 5 year cycle. In light of AK's proposal, USEPA agrees that biological monitoring is appropriate. However, AK's proposal for solely fish tissue monitoring falls short and should be augmented with both sediment monitoring as well as benthic invertebrate monitoring. Details are below. USEPA disagrees with some of AK's assertions within its proposal, such as the assertion that fish tissue concentrations of PCBs are declining. These aspects will not be dealt with here.

1. USEPA agrees that fish tissue monitoring should be conducted immediately prior to remediation activities commencing in Reach 1, so as to establish a pre-remedial baseline. However, sediment sampling to characterize the area pre-remediation should also be conducted.

2. USEPA sees no need for step 3 as proposed, since only a few months will have passed.

3. USEPA agrees with the post-remediation monitoring program for carp and longear sunfish. However, sediment monitoring should also be conducted at several sites to verify that PCBs remain in the target areas and have not been scoured downstream. Sediment monitoring should be conducted as per previously approved protocols (USEPA Method 3545 (pressurized fluid extraction) followed by USEPA Method 680 (homologues).

4. USEPA would like to see a food chain critter analyzed as well as fish, to establish the link between the PCBs in the sediment as well as the PCBs in benthic invertebrates (or worms). The species selected should be one that inhabits Dicks Creek in sufficient numbers such that sampling any location will yield target organisms

5. AK proposed that a 70% reduction of PCBs in fish tissue should be considered success. USEPA suggests the following as alternate measures of success: that any sediment sample collected during the monitoring period shows less than 1 ppm PCB normalized to 1% organic carbon (measures effectiveness of carbon mixing); that benthic invertebrates collected show decreasing levels of PCBs over time; that fish tissue concentrations of PCBs measured over time are reduced such that the PCB fish advisory for DC can be removed.

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ENVIRONMENT

Privileged & Confiential
Attorney-Client Work Product
Prepared at the Request of Counsel

Ms. Mary A. Gade
Sonnenschein Nath & Rosenthal LLP
8000 Sears Tower
233 S. Wacker Drive
Chicago, IL 60606

For Settlement Purposes Only and Inadmissible as Evidence Pursuant to Federal Rule 408

Date:
11 August 2004

Contact:
Timothy Barber

Ext:
11

Email:
tbarber@arcadis-us.com

Our ref:
CL000260.0001

Subject:
Biological Monitoring to Assess Effectiveness of Sediment Treatment

Dear Ms. Gade:

At your request, methods for assessing the effectiveness of proposed sediment treatment measures through biological monitoring are described below.

Two sediment remediation techniques have been proposed for Dick's Creek: (1) sediment removal using hydraulic dredging in the channelized portion of the creek, and (2) stabilization of PCBs by amendment with activated carbon in the non-channelized area between Yankee Road and Main Street. Because PCBs would remain in the sediment in the area treated with activated carbon, biological monitoring is proposed to assess whether PCB bioaccumulation declines in this area as expected. Several options are available for monitoring bioaccumulation, including laboratory assays, placement of caged organisms, and sampling of native biota. Analyses of native fish tissue are proposed for Dick's Creek, because this approach provides a direct measure of conditions occurring in the field.

Biological monitoring will be conducted according to the following general chronology:

1. Establish pre-dredging baseline conditions. While extensive fish tissue data are available from Dick's Creek, these data were collected for risk assessment purposes. In order to statistically evaluate trends over time, it will be useful to sample a smaller number of species, with a larger number of samples per species. Additionally, the existing data indicate a decline in PCB concentrations over the years 1998 – 2002, and PCB concentrations have

likely continued to decline since then. Therefore, fish tissue sampling will initially be conducted immediately prior to dredging activities.

2. Conduct sediment removal measures in the channelized area.

3. Establish post-dredging baseline conditions. Concentrations of PCBs in fish tissue will again be determined after the completion of dredging and before the initiation of activated carbon treatment measures. This is important, because dredging has been observed to cause a temporary spike in chemical bioavailability and bioaccumulation (e.g., Weston et al. 2002; Baumann 1998). Although dredging and activated carbon treatment are not proposed for the same area, upstream dredging could affect PCB bioaccumulation in the proposed activated carbon treatment area.

4. Conduct sediment treatment in the non-channelized area of interest.

5. Conduct post-treatment monitoring. Post-treatment monitoring will be initiated approximately one year after sediment treatment is completed. This will allow time for PCBs to be partially depurated from previously exposed fish and for PCB adsorption to the activated carbon to equilibrate (Buckman et al. 2004; Luthy 2004; Werner et al. 2004). Sampling will be repeated annually until PCB concentrations in fish stabilize (i.e., no statistically significant decreases are detectable over three years).

The monitoring program will focus on two fish species: common carp (*Cyprinus carpio*) and longear sunfish (*Lepomis megalotis*). Carp will be sampled as fillets to represent tissue potentially consumed by humans, and longear sunfish will be sampled as whole fish to represent tissue potentially consumed by wildlife. Carp are selected because they are one of only two large fish species that are abundant enough in Dick's Creek to support a monitoring program. The other large fish species, golden redhorse (*Moxostoma erythrurum*), is highly migratory and therefore unsuitable for long-term monitoring (Trautman 1981). However, it is important to note that carp are not highly valued as game fish and also tend to accumulate higher PCB concentrations than other fish species, due to their high lipid content. Longear sunfish, a small to medium-sized species, are abundant in Dick's Creek and have been consistently collected during past tissue sampling efforts.

During each sampling event, eight composite samples of each species will be collected from the area of interest (Dick's Creek between Yankee Road and Main Street). Fish will be collected throughout the area except at the extreme ends of the reach, to lessen the capture of fish that may be exposed to PCBs outside the area of interest. Each sample will consist of at least three individual fish collected near one another. The location of specific sampling zones within the area of interest will depend on fish abundance and will be recorded in the field. Sampling will be conducted in autumn, because fish typically contain higher lipid concentrations and thus higher PCB levels at this time of year.

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Attorney-Client Work Product
Prepared at the Request of Counsel

If you have any questions or require additional information, please contact me at your convenience.

Sincerely,

ARCADIS G&M, Inc.

Timothy R Barber

Timothy R. Barber, Ph.D.
Principal Scientist

Copies:
Paul Casper, Frost Brown Todd
Dave Horn, AK Steel
John Kuzman, AK Steel
Carl Batliner, AK Steel

References

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ENVIRONMENT

Privileged & Confiential
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Prepared at the Request of Counsel

Ms. Mary A. Gade
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233 S. Wacker Drive
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For Settlement Purposes Only and Inadmissible as Evidence Pursuant to Federal Rule 408

Date:
11 August 2004

Contact:
Timothy Barber

Ext:
11

Email:
tbarber@arcadis-us.com

Our ref:
CL000260.0001

Subject:
Confirmatory Sampling to Establish Vertical Extent of Dredging

Dear Ms. Gade:

At your request, a plan for confirmatory sediment sampling to establish the vertical extent of dredging in Dick's Creek is described below.

Sediment removal has been proposed for the channelized portion of Dick's Creek extending from 50 feet upstream of Outfall 002 to 50 feet downstream of the USGS Gauging Station near Yankee Road. Monroe Ditch will also be dredged. The purpose of the confirmatory sampling described here is to determine the vertical extent of dredging. The specific objective is to verify whether the confining clay layer underlying Dick's Creek and Monroe Ditch serves as a boundary below which PCBs do not occur at significant levels.

Study Design

Sediment core samples will be collected from depositional zones within Dick's Creek at approximately 200 foot intervals (approximately 15 locations). Three samples will be collected from the lower reach of Monroe Ditch, including one sample at the confluence with Dick's Creek and two samples upstream of this point. Each sediment core sample will extend up to two feet into the confining clay layer.

Several sediment samples will be collected within or below the clay layer in each core. For example, samples might be collected from 2 to 6, 6 to 10, 10 to 14 and 14 to 18 inches below the top of the clay layer. The uppermost sample would be analyzed for PCBs, and the remaining samples would be held pending the results of the initial analysis. If PCBs are present above the established cleanup level, additional samples will be analyzed to determine the vertical extent of dredging. The selected samples will be analyzed for PCBs using pressurized fluid extraction and USEPA Method 680 (PCB homologues).

Sampling Methods

Sediment cores will be collected using a vibracoring device. First, an 8-inch diameter section of pipe or other casing material will be advanced into the sediment approximately 6 inches below the sediment surface and dewatered to create a dry work area. Next, a 2-inch wide stainless steel core sampler, with a butyrate core liner, will be advanced up to 6 feet below the sediment surface using a direct current (DC) vibratory head in conjunction with a slide hammer. The core sampler will be extracted from the sediment by hand in conjunction with the slide hammer to lessen the chance for disturbing sample integrity. A basket-type core catcher will be used to retain the sediment core within the butyrate core liner. The liner will be extruded from the sampler, capped, and labeled (top and bottom).

Sediment samples will be collected from downstream to upstream, and sampling locations will be recorded with a global positioning system (GPS) unit. Sample identification codes will be assigned consecutively and will indicate the water body sampled, the medium, the location number, and the sample depth (e.g., DC-CLAY-01-2-8). Sampling logs and field notes will be recorded, according to methods previously established for the site. Sampling logs will include the depth from the sediment surface to the confining clay layer. Sample containers will be appropriately packed, labeled, and placed in coolers with bagged ice for shipping to the analytical laboratory.

Procedures such as decontamination of equipment, data validation, and health and safety measures will be conducted in accordance with the Quality Assurance Project Plan (QAPP) and Health and Safety Plan (HASP) for the site. Disposable equipment will be used where possible to minimize the potential for cross-contamination. One equipment blank will be collected each day for any equipment requiring decontamination. Field duplicate samples will be collected at a rate of 1 per 10 samples, and matrix spike/matrix spike duplicate (MS/MSD) samples will be collected at a rate of 1 per 20 samples. Unused sediment and decontamination fluids will be collected for proper off-site disposal.

If you have any questions or require additional information, please contact me at your convenience.

Sincerely,

ARCADIS G&M, Inc.

Timothy R Barber

Timothy R. Barber, Ph.D.
Principal Scientist

Copies:
Dave Horn, AK Steel
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August 5, 2004

Confidential - Submitted for Settlement Purposes
Protected from Disclosure Pursuant to F.R.E. 408

Steven Willey
United States Department of Justice
Environment and Natural Resources Division
Environmental Enforcement Section
P.O. Box 7611, Ben Franklin Station
Washington, DC 20044-7611

Re: *U.S. et al v. AK Steel Corporation*, Case No. C-1-00530

Dear Mr. Willey:

This letter is being submitted as part of settlement discussions to resolve the above-referenced matter. Accordingly, its contents are protected from disclosure pursuant to Rule 408 of the Federal Rules of Evidence. Per your request, the purpose of this letter is to confirm in writing the steps that AK Steel Corporation ("AK" or the "Company") is prepared to take to address the RCRA corrective action portion of the above-referenced matter pursuant to a global settlement.[1]

On June 17, 2004, the United States provided AK with a proposal to implement a site-wide corrective action program, a copy of which is attached to this letter. AK has reviewed this proposal, and as we discussed at our July 9, 2004 meeting, AK agrees as part of an eventual settlement package to implement this proposed plan with the following exception:[2]

---

[1] AK assumes that the interim measures necessary to address PCBs in Monroe Ditch and Dicks Creek will proceed independently of the RCRA corrective action portion of the project, which is the subject of this letter. AK would assume that these projects would be combined in a global resolution of this matter.

[2] Due to the safety concerns that it has previously raised, AK remains concerned about the performance of intrusive drilling in the closed landfill. This issue continues to be a subject of discussion.

As stated at our July 9 meeting, AK cannot agree to implement any remedies derived from the RCRA Facility Investigation ("RFI"), the Corrective Measures Study ("CMS") and any associated activities. To be specific, the Company cannot agree to undertake the work discussed in the last two sentences of paragraphs 3 and 4, and the last sentence of paragraph 5 of the attached proposal. As we discussed, AK is not in a position to agree to implement a remedy or remedies that have yet to be clearly identified. The remedy or remedies will not be identified until the RFI and CMS have been completed and public comments have been received and addressed.

It is AK's understanding that segmenting a cleanup project in this manner is not an uncommon practice. There are many precedents in both the RCRA and Superfund programs of parties entering into agreements to perform remedial investigation and feasibility work without agreeing to perform the as yet unidentified remedies. In fact, the United States Environmental Protection Agency's ("U.S. EPA's") Advance Notice of Proposed Rulemaking for Corrective Action for Releases from Solid Waste Management Units at Hazardous Waste Management Facilities (the "ANPR") contemplates a division of activities. See 61 Fed. Reg. 19432 (May 1, 1996). In the section on interim measures in the ANPR, U.S. EPA notes the importance of moving forward with interim measures to address contamination while undertaking further studies or before implementing the final remedy. Id. at 19446. Here, AK proposes to undertake both the interim measures work as well as the site characterization for the RCRA corrective action. An agreement to conduct both the interim measures and the site characterization activities will expedite remedial activities at the site.

Segmenting the work in the manner discussed above is of paramount importance to AK due to the financial constraints and economic climate in which our Company operates. Although reporting a net income from operations for the first time in over two years in the second quarter of 2004, AK has reported net losses in excess of $1 billion since 2001. At the end of 2003, the Company had a negative stockholders' equity of $52.8 million. While the stockholders' equity has since returned to a positive number due principally to the sale of certain non-core assets earlier this year, the Company continues to be in a concerted turnaround mode. AK's second quarter earnings were substantially below that of its industry competitors and not yet at a level sufficient to sustain the Company for the long run. Accordingly, we must continue to be diligent in controlling costs and preserving cash wherever possible. Without knowing the scope of the cleanup and the financial costs potentially imposed by any future remedies, the Company cannot in good faith blindly make a commitment to perform these remedies. This is not to say or imply that we intend to try to avoid performing whatever remedies become necessary. We simply cannot make a commitment at this time to perform unknown remedies for which we do not yet know the cost or impact on the Company's ability to ensure its long-term success. While strongly arguing for segmenting any RCRA Corrective Action work, AK fully recognizes that the United States and the State of Ohio would retain their full legal authority to seek implementation of a remedy after AK completes the agreed upon work and acknowledges that segmenting the corrective action would not diminish those authorities or rights. Such a partial settlement would completely address the RCRA Corrective Action characterization, which is the subject of this letter, all remedial work at Dicks Creek, Monroe Ditch and the floodplain, as well as penalties and supplemental environmental projects ("SEPS"), leaving open only the remedial portion of the RCRA Corrective Action count of the ongoing litigation.

As a first step in implementing the agreed to plan, AK has said that it will prepare a Project Management Plan (PMP) to present AK's technical and management approach for the RFI and associated Corrective Action activities at the Middletown Works. You have asked us to provide in greater detail what this PMP will entail. The PMP will include a brief background of the site history and physical setting to set the stage for the conceptual model and exposure pathway analysis. Based on this analysis, important data gaps will be identified to establish the general scope of the RFI. The PMP will not include a detailed summary of past data collection efforts as that would be included in the anticipated "Current Conditions Report." The site will be assessed on a facility-wide basis rather than a Solid Waste Management Unit ("SWMU") by SWMU basis consistent with RCRA Corrective Action reforms. The management approach description will include a phasing of RFI, Interim Measures, and monitoring activities commensurate with the potential exposure as identified in the exposure pathway analysis. It will be assumed that the site will remain industrial for the purposes of the PMP. The PMP will include a brief description of the number and locations of samples, sampling methods, analytical methods, etc. A more thorough discussion of these items will be provided in the Sampling and Analysis Plan ("SAP") and the Quality Assurance Project Plan ("QAPP") expected to be prepared after the US EPA approves the PMP. Similarly for the Interim Measures and monitoring activities, the PMP will not include detailed plans and specifications to guide the implementation as such details would be included in plans prepared subsequent to the approval of the PMP.

The PMP will be the first step in the process leading to the activities identified in the government's attached proposal for an RFI and CMS, and it is intended to facilitate and expedite the work outlined in the proposal.

Sonnenschein
SONNENSCHEIN NATH & ROSENTHAL LLP

In AK's view, the government's agreement to segment the project as set forth above is essential to any settlement. If you have any questions or concerns regarding AK's proposed actions, please do not hesitate to contact me. We look forward to your response.

Very truly yours,

SONNENSCHEIN NATH & ROSENTHAL LLP

Mary A. ——

By:

Mary A. Gade

Enclosure
11750865v-5

cc: David Horn (via e-mail)
John Kuzman (via e-mail)
Ex Kano S. Sams (via e-mail)
Thomas P. Behlen (via e-mail)
Joseph Koncelik (via e-mail)

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RE: U.S., et al. v. AK Steel Corporation, Case No. C-1-00530

June 17, 2004

Site-Wide Corrective Action

Implementation of a site-wide corrective action program consistent with the overall potential for risk to human health and the environment for the site:

Areas with potential releases tributary to the perched or upper aquifer shall be considered high priority;

Areas with potential releases only to the intermediate or lower aquifers which have been shown to be outside the zone of capture of the AK site-wide pumping system shall be considered high priority (e.g., see item 5 below);

Areas with potential releases tributary to the intermediate or lower aquifer shall be considered medium priority.

1. AK shall develop and submit a work plan as follows: (a) for further investigation into, characterization, and remediation of the source of the DNAPL for well MDA33; (b) to install and sample at least 3 additional monitoring wells west of Monroe Ditch, located along west side of both landfills, adjacent to the railroad tracks, to determine and confirm the direction of ground water flow off-site; (c) to install and sample at least 3 additional monitoring wells within the former oil ponds located west of Monroe Ditch, to determine the nature and extent of the contamination present in the soils and ground water associated with the former oil ponds. Upon approval, the work plan shall be implemented consistent with the schedule(s) therein.

2. AK shall develop and submit a current conditions report for the site, which documents all solid waste management units, monitoring wells and past sampling data for each solid waste management unit (soil, soil gas, air, water, ground water) in a comprehensive fashion. This report shall delineate areas where sufficient information exists to adequately characterize the extent of any releases, or where data gaps exist, and shall be used as the basis for future site-wide corrective action planning.

3. After approval of the site-wide current conditions report, AK shall develop and submit a work plan to investigate potential releases to the soil, air, water or ground water within the geographic area tributary to the perched and upper aquifers. This work plan shall include (but not be limited to) additional investigations off-site for the past releases

of coke oven gas and benzene from the melt area. Upon approval, the work plan shall be implemented consistent with the schedule(s) therein. Once the nature and extent of releases are known, AK shall develop a range of corrective measures for those releases which adversely impact human health and the environment. After public notice, AK shall implement the remedy(ies) which USEPA selects. Upon approval, the remedies shall be implemented consistent with the schedule(s) therein.

4. After approval of the site-wide current conditions report, AK shall develop and submit a work plan to investigate potential releases to the soil, air, water or ground water within the geographic area tributary to the intermediate and lower aquifers. Upon approval, the work plan shall be implemented consistent with the schedule(s) therein. Once the nature and extent of releases are known, AK shall develop a range of corrective measures for those releases which adversely impact human health and the environment. After public notice, AK shall implement the remedy(ies) which USEPA selects. Upon approval, the remedies shall be implemented consistent with the schedule(s) therein.

5. AK shall develop and submit a work plan to further delineate the source of TCE contamination in the vicinity of Well GM-27. Upon approval, the work plan shall be implemented consistent with the schedule therein.

Note regarding remedies proposed or recommended: All alternative remedies must meet the 4 threshold criteria specified in the 1996 ANPR: source control; protective of human health and the environment; meets all applicable other state and federal standards; and compliance with RCRA for any materials excavated or removed for disposal off-site. Selection of the recommended alternative will then be made using the 5 other balancing criteria specified in the ANPR, including cost.

Donald F. Hayes, Ph.D., P.E.
1580 Altair Circle • Sandy, UT 840093

DRAFT

August xx, 2004

Mr. Robert Darnell
U.S. Department of Justice
Environment and Natural Resources Division
Environmental Enforcement Section
Room 12082, 1425 New York Ave., NW
P.0. Box. 7611
Washington, DC 20044-7611

Re: United States et al. v. AK Steel Corporation, DJ Number 90-5-2-1-2189

Mr. Darnell,

This letter summarizes my findings on the practicability of dredging PCB-contaminated sediments from Reach 2 of Dick's Creek near Middletown, Ohio (Figure 1). I have taken Reach 2 to extend from general vicinity of Yankee Road (upstream) to the general vicinity of Main Street (downstream). Figure 1 shows this reach of Dick's Creek. This letter serves as my primary work product under Contract/Purchase Order Number 4WENR0107050.

Basis for Evaluation

I have reviewed available site documents, obtained general information on relevant equipment that might be used, and visited the Dick's Creek site on July 29, 2004 with Mr. Gary Casby, EPA Region 5. These findings result from these information gathering efforts combined with my knowledge of dredging equipment, environmental dredging operations, and contaminated sediment management.

Specific documents reviewed include:

- Mikulka, Michael J., "Field & Laboratory Data Report: Physical and Chemical Characterization of Dicks Creek and Associated Flood Plain, Middletown, OH," US Environmental Protection Agency, July 2003.

- A variety of site maps and photographs

Evaluation of Dredging Alternatives

Mechanical Dredging. The dense vegetation and large trees that line Dick's Creek along most of this reach make land-based mechanical sediment removal difficult to accomplish without significant clearing. Not only is access limited by the vegetation, the over story may limit removal to equipment with reach distances less than the creek width; i.e. the equipment would have to work within the banks of the creek. Further, there is insufficient water depth to float

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filled barges with mechanically dredged sediment, although this may be solvable by temporary structures to increase the water depth.

Hydraulic Dredging. Small hydraulic dredges, such as shown in Figure 2, are available that can work within the confines of Dick's Creek. The model shown is a horizontal auger dredge, although similar dredges are available with basket-style cutterheads. With the exception of riffles, existing water depths provide the necessary 25-inch draft; dredging will increase the depth in any places not currently adequate.

Hydraulic dredging adds large volumes of carrier water in order to pump the sediment in a slurry mixture; the slurry mixture will be pumped at near 10% solids, while in situ sediments are likely 60 – 80% solids. Managing this dilute sediment stream is the primary problem associated with hydraulic dredging because of the large flow rate generated by the dredge pump. The traditional approach is to pump the slurry into a confined disposal facility (CDF) to dampen fluctuations in flow and separate the solids from the carrier water. A temporary CDF could be sited on some of the adjacent farmland and slurry pumped to it from the entire reach. After dredging is complete, decanted sediment can be excavated from the CDF and moved to an appropriate landfill. However, effluent from a CDF would need to meet 401 WQ certification requirements imposed by the State of Ohio or discharge to a nearby wastewater treatment plant. Although a wastewater treatment facility exists just downstream of Reach 2, I have not checked to see if they can handle an additional flow of 1.5 MGD or if the treatment processes are capable of sufficient PCB removal to accept the CDF effluent and still meet their NPDES permit limits. Methods for testing sediments and predicting effluent quality from CDFs has been developed by the US Army Corps of Engineers.

An alternative to CDF disposal, however, is to pump the slurry directly into bags made from porous geotextile. The porous geotextile cloth serves retain sediment particles while allowing the carrier water to flow through. Geotextile bags would likely reduce the land area necessary to managed the pumped sediments since filled can be transported immediately to an appropriate landfill after filling. This process has been successfully accomplished at a number of sites and Dr. Jack Fowler of Geotec Associates[1] indicated that site characteristics similar to Dick's Creek seem to be conducive to the use of geotextile bags. Additional general information about the use of geotextile bags and tubes is available at www.geotec.biz.

Much like CDF discharge, the primary concern with hydraulic dredging and pumping directly into geotextile bags is managing the discharge water. Dr. Fowler indicated that a test has been developed to estimate the quality of the discharge water; these tests should provide sufficient information to evaluate various discharge water management alternatives. One alternative would be to pump the discharge water to the local wastewater treatment facility; the same caveats mentioned previously for a CDF also apply to this alternative. Depending upon the testing results, discharging directly back to Dick's Creek may be a consideration. While it is unlikely that the immediate discharge would meet 401 WQ Certification requirements, it might be possible to define the compliance point further downstream in Dick's Creek and construct some pools in the creek to increase retention time and improve water quality before reaching the

[1] Geotec Associates, 5000 Lowry Road, Vicksburg, MS 39180, 601/636-5475.

compliance point. For example, the bridge at Jackson Street could be used as such a structure and other temporary retention structures could be constructed downstream from sheetpile.

Costs

Costs for the dredging operation as described should be approximately that for a typical dredging operation with additional costs for managing the discharge water, sediment transport and disposal, and purchasing the geotextile bags. I have not attempted to gather any specific cost information, but I anticipate the costs to be \$100/cy to \$150/cy.

Findings

Based upon the available information, a site visit to Dick's Creek, and my experience in dredging, I firmly believe that PCB contaminated sediments in Reach 2 of Dick's Creek near Middletown, OH can be removed using readily available dredging equipment. These finding should not be construed as a recommendation for dredging of Dick's Creek as my evaluation does not include consideration of any other remedial option.

Sincerely,

Donald F. Hayes, Ph.D., P.E.

MUD CAT™ AUGER MODEL SP-810	
Length (O.A.)	28 ft 6 in (8.68 m)
Width (O.A.)	8 ft 0 in (2.44 m)
Height (O.A.)	9 ft (2.85 m)
Weight	15,500 lbs (7030 kg) dry
Draft	25 in (0.64 m)
Fuel Capacity	180 gallons (680 liters)
Cut	8 ft (2.44 m) wide x 18 in (.457 m) maximum depth
Operating Depth	10.5 ft (3.2 m) Maximum
Suction Diameter	6 in (152 mm) (8 in [203 mm] available as option)
Discharge Diameter	6 in (152 mm)
Nominal Pump Performance	1000 GPM (3785 liters/min) against 100 ft (30.5 m) Head (water) at 1600 RPM

Figure 2. Photograph of Mudcat SP-810 and specifications from www.Ellicott.com.

Figure 1. Map of Dick's Creek, Reach 2, which is about 1 mile in length.

10/6/04

NET ENVIRONMENTAL BENEFITS ANALYSIS FOR REACH 2 REMEDIAL ALTERNATIVES

DICK'S CREEK, MIDDLETOWN, OHIO

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Phyllis C. Fuchsman
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Timothy R. Barber, PhD
Principal Scientist, Project Manager

Net Environmental Benefits Analysis for Reach 2 Remedial Alternatives

Dick's Creek, Middletown, Ohio

For Settlement Purposes Only and Inadmissible as Evidence Pursuant to Federal Rule 408

Prepared for:
AK Steel Corporation,
Middletown, Ohio

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Our Ref.:
CL000260.0001

Date:
October 6, 2004

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Prepared at the Request of Counsel

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Acronyms

DBH	Diameter at breast height
EPT	Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies)
IBI	Index of Biotic Integrity
ICI	Invertebrate Community Index
IWB	Index of Well-Being
OEPA	Ohio Environmental Protection Agency
PCB	Polychlorinated biphenyl
QHEI	Qualitative Habitat Evaluation Index
USEPA	United States Environmental Protection Agency

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1. Introduction

This report evaluates and compares the environmental costs and benefits of remedial options proposed for Reach 2 of Dick's Creek, which encompasses the area of the creek between Yankee Road[1] and Main Street in Middletown, Ohio (see Figure 1). The two remedial alternatives under consideration are:

1. In situ sequestration of PCBs by activated carbon amendment, and

2. Sediment removal by hydraulic dredging.

In situ sequestration is being considered for Reach 2 in part because polychlorinated biphenyl (PCB) levels are lower in this area than in Reach 1, which encompasses the channelized creek segment between AK Steel Middletown Works' Outfall 002 and Yankee Road. Sediment removal is proposed for Reach 1. The evaluation of these alternatives is consistent with the U.S. Environmental Protection Agency's *Principles for Managing Contaminated Sediment Risks at Hazardous Waste Sites* (USEPA 2002a), which recognizes that the combination of sediment dredging in hot spots and in situ remedies in less contaminated areas will be the most effective way to manage risks at many sites.

According to the USEPA's (1999) *Ecological Risk Assessment and Risk Management Principles for Superfund Sites*, risk managers should consider the short- and long-term effects of the remedial alternatives on site habitats and the surrounding ecosystem, to ensure that cleanup does not cause more ecological harm than the existing site contamination. In the *Contaminated Sediment Principles*, the USEPA (2002a) also recommends consideration of societal impacts, such as road traffic, noise, and air pollution, for each remedial alternative. This type of comparative evaluation is necessary to ensure that the selected remedy maximizes net environmental benefits. Toward that end, the remainder of this report provides a description of the proposed remedial actions and the existing natural resources in Reach 2, followed by an analysis of the expected environmental detriments and benefits of each remedial alternative.

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[1] More precisely, the boundary between Reach 1 and Reach 2 is the edge of non-channelized habitat; channelization extends a few hundred feet downstream of Yankee Road.

2. Description of Remedial Alternatives

Aspects of each remedial alternative that are relevant to the net environmental benefits analysis are described below. Once a remedial alternative is selected, the implementation methods will be developed fully in a comprehensive work plan.

2.1 In Situ Sequestration

The proposed in situ sequestration remedy is based on recent research demonstrating that the bioavailability of PCBs in sediment can be significantly reduced through the addition of activated carbon to the sediment (Luthy 2003; 2004; Werner et al. 2004; Zimmerman et al. 2004). Laboratory studies have demonstrated a long-term reduction in PCB bioaccumulation of approximately an order of magnitude following treatment with activated carbon (Luthy 2004). The observed reduction in PCB bioavailability and bioaccumulation occurs because hydrophobic organic compounds adsorb much more strongly to activated carbon than natural organic carbon.

A slurry of powdered activated carbon would be introduced into the sediment through pressurized injection, using a hand pump connected to a perforated wand. Pre-implementation trials identifying the extent of activated carbon perfusion in Dick's Creek sediment would be used to determine the spacing of injection points. It is anticipated that relatively close spacing would be required. The entire creek bed in Reach 2 would be treated, including depositional areas and riffles. The injection treatments would be conducted on foot (wading), with equipment towed in a small boat.

A biological monitoring program would be implemented after the completion of sediment treatment to verify the expected reduction of PCB bioaccumulation in fish tissue. Fish tissue sampling would be repeated over time to determine trends in PCB concentrations. The monitoring program would focus on two fish species: common carp (*Cyprinus carpio*) and longear sunfish (*Lepomis megalotis*). Carp would be sampled as fillets to represent tissue potentially consumed by humans, and longear sunfish would be sampled as whole fish to represent tissue potentially consumed by wildlife. Although carp are not the most abundant large fish species in Reach 2, the other large fish species are highly migratory and therefore unsuitable for long-term monitoring purposes.

2.2 Dredging

The sediment removal alternative would employ hydraulic dredging technology to remove sand and fine-grain sediment in the form of a sediment/water slurry. Coarse material such as large gravel or woody debris would not be dredged as sediment but might be removed for convenience. Multiple options are available for hydraulic dredging. For instance, dredging could be implemented on foot, using a hand-held cutter-head dredge. The dredged material would be transported by vacuum suction through a flexible pipeline to an on-shore container. The material would then be transported by truck to a staging area for dewatering and subsequent off-site disposal. Alternatively, Donald Hayes (2004) outlined an option involving a Mud Cat dredge, which cuts and loosens a swath of sediment 8 feet wide and up to 18 inches deep; the sediment is then captured with a 6 inch diameter suction hose. Depending on the target depth of dredging, multiple passes could be required. Sediment dredged in this manner would be pumped directly to a confined disposal facility or similar staging area for dewatering. Because the Mud Cat requires a water depth of 25 inches, riffle areas might need to be removed to allow access throughout Reach 2.[2] The primary differences between these two options are that (1) dredging on foot with a hand-held cutter-head dredge would allow closer targeting of sand and fine-grain sediment, while the Mud Cat would result in wholesale removal of larger segments of the stream bed; and (2) dredging on foot would require more closely spaced access points along the shoreline, while the Mud Cat would operate entirely within the stream channel.

During a conference call on August 26, 2004, Dr. Hayes suggested that impacts on the aquatic habitat due to dredging could be addressed through stream restoration, although he did not describe the nature of such restoration efforts as part of his evaluation of dredging alternatives (Hayes 2004). Stream restoration could involve the placement of instream structures, such as large woody debris, as well as gravel, sand, or other fill material to replace the dredged sediment. Bank stabilization might also be conducted, using techniques such as bank armoring, tree planting, or a combination of the two. Large volumes of material would need to be transported to targeted restoration sites and placed into the creek using heavy equipment.

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[2] Hayes (2004) also suggested that the creek could be dammed to raise the water level to the required depth, but this would cause flooding and could potentially contaminate large areas of the floodplain with material resuspended by dredging efforts.

The dredging alternative would likely require construction of several staging areas and access roads, as shown in Figure 2. Access roads would be needed for dredging with hand-held equipment or for transporting restoration materials to the creek. For this assessment, it is assumed that access points to the creek would be required at intervals of approximately 500 feet. Under the hand-held dredge option, each staging area would serve a stream segment approximately 1,500 to 2,500 feet in length and would contain multiple roll-off-type containers, dewatering equipment, and a water treatment facility. For this assessment, staging areas are each assumed to occupy approximately 1.25 acres (250 by 250 feet). Under the Mud Cat option, one 5-acre parcel would be used for sediment storage and dewatering (Hayes 2004). Access roads connecting the staging areas with the creek would be one-lane roads with a turnaround at the end, large enough to accommodate a semi-tractor trailer (i.e., road width of approximately 12 feet). Access roads connecting the staging areas with city streets would be double-wide.

The siting of staging areas and access roads would be contingent on access agreements with property owners. Figure 2 represents an optimal scenario, where all staging areas are constructed in open fields rather than wooded areas. Even under these circumstances, tree clearing would be required to construct access roads to the creek. Upon completion of dredging, all staging areas and roads would be removed, and the affected areas would be replanted.

Wastewater generated by the dewatering of dredged material would be treated and discharged back to Dick's Creek. The dewatered sediment would be trucked to an off-site landfill for permanent disposal. Approximately 19 million gallons of wastewater would require treatment, and 8,300 cubic yards of sediment (12,000 tons) would require disposal. Resuspension and downstream transport of contaminated sediment during dredging would be minimized to the extent possible through the choice of dredging equipment and the use of silt screens or silt curtains, as needed.

3. Existing Natural Resources

It should be evident from the above description that the dredging alternative would entail substantial disruption of the aquatic and riparian (stream-side) habitat in Reach 2. In order to understand the associated environmental "side-effects," it is necessary to understand the types and quality of natural resources currently present in the area. Therefore, a site visit was conducted on August 17-18, 2004, to characterize riparian vegetation and ground-truth land cover types adjacent to Reach 2, as well as characterizing aquatic habitat quality. Additional information was obtained from recent aerial photographs and from fish and invertebrate community surveys conducted in 2000 and 2001.

3.1 Riparian Habitat

Riparian zones exist along the physical and biological gradient between streams and upland areas, and they area critically important to both of these environments. A functioning riparian zone serves as a source of food and cover for aquatic organisms (in the form of fallen leaves and woody debris), decreases the severity of erosion and flood scour, and serves as a low-flow refugium for aquatic organisms during major floods (Sedell et al. 1990). From a terrestrial perspective, the riparian zone provides cover for organisms that use the river as a source of food and water. Additionally, the high variability of soil properties and water regimes over short distances results in a high diversity of plant species and communities, which in turn are used by a wide variety of invertebrates and wildlife (Gregory et al. 1991). As land use has changed with increasing human populations, riparian zones have become particularly important as corridors for the movement of animals (Hodges 1997).

Figure 3 shows land use and land cover characteristics within ¼ mile to either side of Reach 2, based on aerial photography and site observations. The most extensive land cover types are deciduous woodland (26% of the area), agricultural fields (25%), and residential property (24%). Other land cover types include commercial, industrial, and public properties such as the Amanda Elementary School (12%), transportation corridors (6%), other open land, including mowed areas and fallow fields (4%), and surface water (2%).

Portions of Dick's Creek were deepened and straightened (i.e., channelized) by the Miami Conservancy District during the 1960s, for flood control purposes. Channelization resulted in major, long-term habitat degradation, in both the riparian and aquatic components of the stream ecosystem (see Figures 4 and 5 for a comparison of riparian landscape characteristics). Most of the channelization took place upstream of Reach 2; approximately 70 to 75% of Reach 2 was not channelized. However, the area between State Route 4 and Main Street was channelized. The following sections describe vegetation characteristics in the non-channelized and channelized areas, followed by a short discussion of riparian wildlife.

3.1.1 Plant Community in the Non-Channelized Riparian Zone

As illustrated in Figure 3, the north side of the wooded riparian buffer zone varies in width, ranging from less than 10 feet to greater than 200 feet. The primarily steep creek banks along this stretch range from 2 to 12 feet high and are mainly composed of sandy clay, but there are also sections where bedrock is exposed. At the tops of the banks, the habitat tapers off to a flat hardwood bottomland/riparian forest which then opens up to fields, either fallow or agricultural. All of the normal vegetation strata are present (i.e. tree, shrub, herbaceous, and groundcover) and are described below.

The tree layer is dominated, in terms of count and size, by box elder (*Acer negundo*), sycamore (*Platanus occidentalis*), and American elm (*Ulmus americana*) (see Figure 6). Other less dominant tree species found throughout this habitat include characteristic bottomland species such as hackberry (*Celtis occidentalis*), persimmon (*Diospyros virginiana)*, musclewood (*Carpinus carolinana*), Ohio buckeye (*Aesculus glabra*), and several other species listed in Table 1. The upper canopy (approximately 120 feet high with 25% canopy closure) was dominated by the oldest and largest trees (sycamores and cottonwoods (*Populus deltoides*)) with an average basal diameter at breast height (DBH) of 32 inches. The middle canopy (approximately 75 feet high and 75% canopy closure) was dominated by trees ranging from 4 to 20 inches DBH, such as box elder, American elm, and the other less dominant trees mentioned above.

Qualitative measurements of the tree community were collected in the wooded riparian buffer zone to assess tree density, size and canopy closure. Measurements were taken primarily in the area near the Amanda School and the unnamed tributary but appeared to be representative of the entire non-channelized riparian zone. Overall canopy closure within the wooded riparian buffer zone averaged 87%, varying from approximately 75% to 95% canopy closure, as measured with a spherical densiometer. The density of trees with a DBH greater than 4 inches was measured with a basal area factor prism and averaged 10 trees per plot (approximately 60 feet radius), ranging from 5 to 16 trees per plot. This equates to an average of approximately one large tree per 40 square yards.

The shrub layer is very dense throughout the majority of the area and substantially increases the relative vegetation density and canopy closure. This layer ranges in height from 4 to 20 feet and consists mainly (approximately 80%) of Amur honeysuckle (*Lonicera maackii*), with the remaining 20% from sporadic occurrences of privet (*Ligustrum vulgare*), multiflora rose (*Rosa multifora*), and maple-leaf viburnum (*Viburnum acerifolium*). Among these species, only the viburnum is native to Ohio; the remainder are invasive exotic species (see Figure 7). The Amur honeysuckle dominates the lower canopy layer and, when combined with the mid and upper canopies, blocks enough sunlight to eliminate undergrowth throughout much of the area.

The herbaceous layer is sparse throughout the area with the exception of the fringes of the woods, where an interface niche of vegetation occurs between the closed canopy of the woods and adjacent fields (see Figure 8). At these interfaces, wingstem (*Verbesina alternifolia*), green headed coneflower (*Rudbeckia laciniata*), and forest sunflower (*Helianthus decapetalus*) are found throughout the herbaceous stratum along the periphery of the entire wooded riparian buffer zone. The herbaceous stratum is diverse and also contains Joe Pye weed (*Eupatorium* spp.), blue vervain (*Verbena hastata*), clearweed (*Pilea pumila*), false nettle (*Boehmeria cylindrica*), ragweed (*Ambrosia artemisiifolia*), common dayflower (*Commelina communis*), great blue lobelia (*Lobelia siphilitica*), dame's rocket (*Hesperis matronalis*), and pale touch-me-not (*Impatiens pallida*), as well as numerous other herbaceous species not documented or identified because they were not flowering or were not evident at the time of the survey (e.g., ephemeral spring wildflowers).

Groundcover is present in the form of various twining and climbing vines. The dominant species in this stratum are the herbaceous vines Japanese hops (*Humulus japonicus*) and greenbrier (S*milax* spp.) and the woody lianas Virgina creeper (*Parthenocissus quinquefolia*), river grape (*Vitis riparia*), and poison ivy (*Rhus radicans*). Wintercreeper (*Euonymus fortunei*), an escaped ornamental species, is also present in some areas. Though not ubiquitous, vines such as river grape and Virginia creeper dominate some trees as they creep into the canopy striving for sunlight. Japanese hops tends to stay sprawled closed to the ground, running over the herbaceous stratum. Poison ivy is present both as a ground cover and a climbing vine, even forming tree-like branches from the main trunks of host trees.

Overall, the plant community in the wooded riparian zone is characterized by a high-quality tree community and a disturbed understory. The tree community is quite diverse with many sycamores and other slow-growing tree species. By comparison, dominance by fast-growing pioneer species such as silver maple (*Acer saccharinum*), cottonwood, and box elder would have been indicative of a formerly disturbed lowland hardwood forest (Hodges 1997). Invasive species are a significant problem in the shrub stratum, crowding out native shrubs, tree saplings, and herbaceous plants.

3.1.2 Plant Community in the Channelized Riparian Zone

Riparian vegetation in the area between State Route 4 and Main Street is characterized as a maintained meadow. This area is dominated by the herbaceous stratum (greater than 95%), but some shrubs are also present. Vegetation appears to be mowed frequently; thus it is composed mainly of grasses (panic grass (*Panicum* spp.) and brome grass (*Bromus* spp.)), with the exception of a ten foot unmowed buffer along the creek's edge. This buffer appears to be maintained at a maximum height of ten feet, as evidenced by the shrubby box elder and staghorn sumac (*Rhus typhina*) individuals present. Dominant plants in this narrow buffer consist of grasses, goldenrods (*Solidago* spp.), and smartweeds (*Polygonum* spp.). Other, less dominant species include rushes (*Juncus* spp.), ragweed, clearweed, false nettle, and Joe Pye weed.

The overall landscape of the maintained meadow area is designed for flood control rather than habitat quality. The creek here is an average of 25 feet wide and one foot deep, with gradual sinuosity and shallow riffles. The immediate creek bank rises approximately six feet to a plateau area, which is roughly 100 feet wide, and rises another 25 feet to a berm. This berm and plateau system serves to contain flood waters.

3.1.3 Riparian Wildlife

During the course of the qualitative vegetation and habitat assessments, incidental observations were made of the wildlife activity along the northern side of Reach 2. Evidence of wildlife was noted in the form of direct sightings, tracks, scat, collections and photo-documentation. In general, wildlife seemed to be abundant within the riparian buffer area. Characteristic representatives of the various trophic guilds were present, ranging from macroinvertebrates to birds of prey.

Observed macroinvertebrates included: insect larvae and adults from the order Odonata and family Chironomidae (damselflies, dragonflies, and midges) in the creek and air; water beetles (family Haliplidae) on the surface; horseflies (sub-order Brachycera); cicada (family Cicadidae); mosquitoes (*Anopheles* spp.); crayfish (*Pacifastacus leniusculus*), and shells of fingernail clams (class Bivalvia).

The presence of amphibians was evident, based on: (1) the unidentified calls of different frogs heard in the distance near the shoreline and woods; and (2) visual observations of many frogs along the banks. One reptile, a juvenile northern water snake (*Nerodia sipedon*), was observed in the channelized area of Reach 2 swimming in the creek. No turtles were observed, but suitable basking habitat exists along the creek in the form of fallen logs.

Beaver (*Castor canadensis*), opossum (*Didelphis virginiana*), and white tail deer (*Odocoileus virginianus*) tracks were repeatedly observed up and down the creek banks. A deer carcass was found next to the creek in the channelized area. This was the largest mammal encountered during the site visit, albeit dead. Active beaver slides and burrows were observed in both banks, as well as dismantled vegetation along the northern shoreline and woods. The burrows could also have been from muskrats (*Ondatra zibethicus*), as immediate diagnostic tracks were lacking. Other animal tracks and scat were observed, suggesting the presence of raccoons (*Procyon lotor*) and another inconclusively identified mammal species (probably muskrat). Squirrels (*Sciurus* sp.) were observed in trees in the wooded area to the north of the creek.

Birds were the most abundantly observed group of animals. Goldfinches (*Carduelis tristis*) were active along the fringes of the woods. Swallows (Family Hirundinidae) were active over the creek as they foraged along the surface; the site visit evidently took place concurrent with insect emergence. A kingfisher (*Ceryle alcyon*) caught a small baitfish and then flew into the woods to consume it. The presence of woodpeckers (order Picidae) was indicated by holes in trees, as well as the sounds of woodpecker calls and hammering. A red-tailed hawk (*Buteo jamaicensis*) was observed circling over Amanda School and zigzagging along the creek. Lastly, an unidentifiable dead duck was observed along the shore of the northern wooded area.

3.2 Aquatic Habitat

This section describes the physical habitat of the stream and the fish, macroinvertebrate, and aquatic plant communities present in Reach 2.

3.2.1 Physical Habitat

High quality aquatic habitat is generally characterized by a high diversity of microhabitats, including a variety of velocity-depth combinations and substrate types and an abundance of instream cover (such as snags or overhanging banks). In contrast, channelization tends to result in a homogeneous and exposed habitat that is suitable for fewer aquatic species. In Ohio, aquatic habitat quality is typically rated using the Ohio EPA's (1989a) standardized Qualitative Habitat Evaluation Index (QHEI). The QHEI assesses a variety of stream attributes, including substrate type, siltation/embeddedness, type and amount of instream cover, channel morphology, riparian zone extent and quality, bank erosion, and pool, riffle, and run quality.

ARCADIS staff trained in QHEI methods assessed habitat quality in Reach 2 of Dick's Creek at six locations during the August 2004 site visit (see Figure 1). Note that location A is actually within the channelized area just upstream of Reach 2. Photographs of each location and copies of the QHEI field sheets are provided in Appendix A; results are summarized in Table 2. Data are also available from previous surveys conducted in 2000 by Ohio EPA (2000) and in 2001 by EA Engineering, Science and Technology (EA 2002) in the area near the Amanda Elementary School (Table 2).

In the channelized areas at the upstream and downstream ends of Reach 2, habitat quality ranges from poor to fair. Habitat quality is good throughout most of the non-channelized area but was rated only as fair in the downstream-most portion of the non-channelized area, due in part to a lack of riffle habitat. This area experiences a damming effect due to culverts and bridges downstream. In general, channel morphology and instream cover are particularly favorable in the non-channelized area, while moderate to heavy siltation and sediment embeddedness are detrimental. Riparian cover is dramatically better in the non-channelized area compared to channelized portions of the creek, although the width of the wooded riparian zone is variable.

3.2.2 Fish

The fish community in Reach 2 is characteristic of a small stream. Small fish (minnows and darters) are prevalent, and large fish consist primarily of bottom feeders (suckers, catfish, and carp). A small number of bass are also present, but the creek is not large enough to support many piscivorous fish.

Fish observed during the August 2004 site visit included common carp (*Cyprinus carpio*), bluegill (*Lepomis macrochirus*), channel catfish (*Ictalurus punctatus*), smallmouth bass (*Micropterus salmoides*), and many large schools of unidentified minnows and bait fish varying in length from one inch to four inches. Some schools were large enough to fill the creek from bank to bank and eight feet in length. These species were found throughout the reach, near structure/habitat features such as cobbles, snags, as well as in open water and riffles.

Two types of formal fish surveys have been conducted in Reach 2. The Ohio EPA (2000) and EA (2002) used standardized, semiquantitative methods to calculate indices of fish community quality, namely the Index of Biotic Integrity (IBI) and the modified Index of Well-Being (IWB). In addition, EA (2001) used depletion sampling to develop quantitative population estimates for large fish (greater than 6 inches in length). The sampling location for all of these surveys was behind the Amanda Elementary School (approximately location D on Figure 1). Survey results are summarized in Table 3.

Fish community quality was assessed based on the IBI and the mIWB. The IBI is a fish assemblage assessment approach initially developed by Karr (1981). It incorporates the zoogeographic, ecosystem, and community and population aspects of the fish community into a single ecologically-based index. Calculation and interpretation of the IBI involves a sequence of activities, including fish sample collection according to Ohio EPA electrofishing procedures (Ohio EPA 1989b), data tabulation, and comparison to regionally calibrated expectation values (Ohio EPA 1988a,b; 1989b). The IBI indicates fish community quality by incorporating 12 metrics that evaluate overall fish condition. Metrics include such variables as number of species collected, catch rate, and the number of sunfish species. The Index of Well Being (IWB) indicates fish community quality more simply, through the incorporation of measured richness of nontolerant species, biomass, and abundance of fish. The mIWB is Ohio EPA's modification of the original IWB index developed for the Wabash River in Indiana.

In 2000, the IBI score for Reach 2 (33) was below the Ohio EPA's criterion for warmwater habitat (40); however, the 2001 score (42) was above the criterion. In the 2001 survey, the relative abundance of tolerant species and omnivores decreased, and additional sunfish and sucker species were observed, leading to the higher IBI score. The mIWB scores were identical between the two sampling events (7.8); this score is considered an insignificant departure from the warmwater habitat criterion of 8.2 (Ohio EPA 1988b). Taken together, these studies indicate that the fish community occurring in Reach 2 is consistent with expectations based on physical habitat quality.

The quantitative survey of large fish populations found that golden redhorse (*Moxostoma erythrurum*) was by far the most dominant large fish in Reach 2. These fish were generally 6 to 7 inches long, although specimens up to a foot in length were observed (EA 2001). The Ohio EPA classifies this round-bodied sucker species as a specialized insectivore that is moderately intolerant of pollution. It prefers pool habitat and requires clean gravel or cobble substrate for spawning (Ohio EPA 1988b). Golden redhorse is thought to be seasonally migratory (Trautman 1981). Other relatively abundant large fish in the quantitative survey included white suckers (*Catostomus commersoni*), channel catfish (*Ictalurus punctatus*), and common carp (*Cyprinus carpio*).

3.2.3 Macroinvertebrates

The quality of the invertebrate community in Reach 2 was evaluated concurrently with the fish surveys described above (Table 4). Quantitative collections were made with modified Hester-Dendy artificial substrate samplers, and qualitative samples were collected by kick netting and handpicking, following procedures specified by OEPA guidance (OEPA 1988a,b; 1989a,b). These data provide a means of evaluating benthic invertebrate community quality, using OEPA's criteria for the Invertebrate Community Index (ICI). The ICI consists of ten individually scored structural community metrics, including total number of taxa, percent tolerant organisms, and the relative abundance and taxa richness of Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies) taxa (EPT). The EPT are considered to be particularly sensitive to water quality disturbances. The scoring of an individual sample is based on the relevant attributes of that sample compared to equivalent data from 232 reference sites in Ohio.

Macroinvertebrates are abundant in Reach 2 of Dick's Creek. More than 2,000 organisms representing more than 50 taxa colonized the artificial substrate samplers during each sampling event. The aquatic life stages of various insects were dominant in terms of abundance, but large invertebrates such as crayfish and mollusks were also present and are important in terms of biomass. Invertebrates provide an important food source for many of the fish species found in Reach 2, as well as insect-eating wildlife such as songbirds and frogs.

The ICI scores reported in 2000 (34) and 2001 (32) are considered an insignificant departure from the warmwater habitat criterion of 36, in accordance with Ohio EPA guidance (Ohio EPA 1988b). Both sensitive and tolerant species were abundant, including caddisflies (sensitive), Tanytarsini midges (sensitive), and *Cricotopus* sp. midges (tolerant). Overall, invertebrate community quality in Reach 2 is consistent with expectations based on habitat quality, particularly considering the limitations of the upstream watershed, which is heavily impacted by channelization and urban/industrial land use.

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3.2.4 Aquatic Plants

Aquatic vegetation is relatively sparse in the non-channelized portion of Reach 2, but some areas contain small patches (less than five square feet) of curly pondweed (*Potomogeton crispus*) and water weed (*Elodea* spp.) in shallows directly downstream of riffles (see Figure 9). In the channelized area, the same species are present at greater densities, due to the 100% open canopy. Microvegetation (e.g., algal films) was not characterized during the August 2004 site visit. Aquatic vegetation serves as both food and instream cover for fish and aquatic invertebrates and is also consumed by herbivorous wildlife (e.g., waterfowl).

4. Environmental Costs of Remedial Alternatives

4.1 In Situ Sequestration

The addition of activated carbon to the sediment as proposed would be relatively benign in terms of environmental side-effects. The most notable adverse impact would be trampling of the streambed during the activated carbon injection process. Some benthic organisms would likely be crushed, and some sediment resuspension would likely occur. The latter could potentially increase PCB bioavailability in the short term, but any such effect would be rapidly counteracted by the sorptive capacity of the activated carbon. If necessary, downstream transport of resuspended material could be minimized using silt screens or silt curtains. However, during past sediment sampling events it has been noted that the predominance of sand rather than fine-grain sediment tends to limit sediment resuspension and transport in Dick's Creek. It should also be noted that the issue of sediment resuspension applies equally to the dredging alternative.

It is also possible that the activated carbon could sorb natural organic chemicals that would otherwise be available to organisms, perhaps causing a slight decrease in microbial activity within the reach.

4.2 Dredging

The removal of sediment from Reach 2 would be a major undertaking, with dredging, transportation, treatment, and disposal of large amounts of material. As such, adverse impacts would occur in and adjacent to the reach, as well as off-site, as described below.

4.2.1 Riparian Habitat

The most obvious effect of the dredging alternative on riparian habitat would be the removal of trees and understory plants for the creation of access roads. As described in Section 2.2, access roads would be constructed either to support dredging with hand-held equipment or for transportation of stream restoration materials to the creek. Based on the schematic shown in Figure 2, approximately 1.8 acres of wooded habitat would be removed. The immediate effect would be tree loss; based on the tree density described above, more than 200 large trees would be cleared. Although the access roads would be taken up and the areas replanted upon completion of dredging, a recovery time of several decades would be required to reestablish the presence of trees as large as those currently occurring in this area. Additionally, road construction and use would compact the soil, impeding recovery of the plant community even after road removal.

The presence of disturbed corridors through the riparian zone also would serve as a pathway for further expansion of exotic nuisance species already occurring in the area, such as Amur honeysuckle. This species tends to displace native understory vegetation and reduces tree regeneration in disturbed areas (Batcher and Stiles 2000). If native vegetation is to be established in the replanted areas, ongoing maintenance would be required to remove honeysuckle and other noxious invasive species, such as Japanese hops and the non-native spring ephemeral garlic mustard (*Alliaria petiolata*), which would rapidly colonize the disturbed areas. In the absence of active maintenance, these fast-growing species, together with poison ivy, would tend to out compete other species for sunlight, setting the stage for low biodiversity. To the extent that herbicides might be used for invasive species control, chemical toxicity could also become an issue.

The effects of road construction on woodland habitat would not be limited to the road cut itself. Invasive species that colonize the cleared area would tend to expand their presence in the adjacent habitat as well. The increase in "edge" habitat would favor edge-associated plant and animal species, including nest parasites such as the brown-headed cowbird (*Molothrus ater*) (Saunders et al. 2002). Also, during the implementation of dredging, the intense human activity in the riparian zone would cause short-term avoidance of the area by wildlife.

Tree removal would affect aquatic habitat quality by exposing portions of the creek to direct sunlight and eliminating the source of woody debris to the creek in the affected areas. Woody debris is a major component of instream habitat (Wallace 1990). Also, trees are important to bank stability in Reach 2, and their removal would increase the likelihood of bank erosion. To limit these impacts, access roads would be set back from the creek where possible, but the existing riparian cover would be eliminated at 500 foot intervals along the entire reach to accommodate the necessary access points.

Indirect, long-term effects on riparian habitat could also occur, to the extent that sediment removal results in long-term channel incision. As shown in Figure 10, channel incision is typically accompanied by bank erosion, which ultimately leads to channel widening and formation of a terraced riparian zone. In addition, channel incision lowers the adjacent water table, potentially affecting riparian vegetation (Federal Interagency Stream Restoration Work Group 1998). Conditions that could result in significant channel incision are discussed further below.

Finally, all of these impacts would be dramatically more severe if it became necessary to construct a staging area in wooded habitat. For instance, if access were denied for a staging area adjacent to the Excello Trailer Park or the Amanda Elementary School, then much more tree removal would be required compared to the scenario portrayed in Figure 2. In addition to the impacts described above, such extensive clear-cutting would compromise the hydrological and ecological function of the riparian zone and would significantly reduce available habitat for wildlife.

4.2.2 Aquatic Habitat

Dredging would significantly alter the physical aquatic habitat and essentially remove the benthic invertebrate community throughout Reach 2. In addition to the obvious effect on the invertebrates themselves, short-term impacts would include the loss of local habitat and a key food source for invertebrate-feeding fish and wildlife, including aquatic-feeding wildlife and birds that feed on emergent aquatic insects. The impacts associated with dredging on the habitat and biological community of aquatic systems are discussed below.

4.2.2.1 Physical Habitat

The immediate effect of dredging would be a deepening of much of the stream channel within the reach. Assuming hand-held dredging equipment would allow targeted removal of depositional sediment only, the channel would initially be deepened by less than a foot on average. However, the depth of the channel would exhibit extreme variation compared with current conditions, leading to channel instability, erosion, and channel incision. Undercutting of the stream banks during dredging, as well as riparian tree removal, would further contribute to channel instability and subsequent channel incision. While this process might result in a return to high-quality habitat conditions over the very long term, in the interim years it would cause habitat degradation due to substrate instability and erosion-related siltation. As described by Shields et al. (1998), "channel incision and attendant erosion and sedimentation represent one of the most powerful destructive influences acting on stream corridor ecosystems."

One factor that would tend to counteract channel incision would be the higher elevation of the stream bed in the un-dredged area downstream, relative to the average post-dredging elevation in Reach 2. It is difficult to predict whether a damming effect or an erosional effect would be dominant after completion of dredging. A damming effect would also be quite detrimental to habitat quality in the long term, because riffle habitat would be compromised by increased water depth and slower velocity.

More severe effects on aquatic habitat quality would result if a Mud Cat type dredge were used rather than hand-held dredging equipment. Because the stream bed would be removed in large swaths, the instream topography would become homogenous, similar to a channelized stream. As demonstrated by the difference in Ohio EPA's biological criteria for channelized (Modified Warmwater Habitat) versus non-channelized streams (Warmwater Habitat), the habitat modifications associated with channelization cause severe, long-term degradation of the ability of aquatic habitat to support fish and invertebrates. In addition to the degradation of stream bed morphometry, removal of instream cover structures such as logs and boulders might also be necessary for proper operation of a Mud Cat dredge, further compromising habitat quality. Also, the need for heavy equipment access to remove such large objects would contribute to disturbance of the riparian zone (see Section 4.2.1). On the other hand, if large objects are not removed from the stream, the effectiveness of Mud Cat type dredging in removing PCB-contaminated sediments would be diminished (see Section 5.2).

The ability of stream restoration techniques to recreate pre-dredging habitat conditions is highly uncertain. Our literature review identified no documented instances in which stream restoration was conducted following a dredging operation. Although interest in stream restoration has increased in recent years, few restoration projects have been monitored to determine whether the ecological functions of the stream are in fact restored over the long term (Moerke and Lamberti 2004; Shields et al. 2003). The limited available data indicate mixed success of stream restoration attempts. Among the reasons for failure are washout of installed structures, sedimentation from upstream reaches, poor connectivity with high-quality sources of fish or invertebrate colonization, inapplicability of restoration techniques between different stream types (e.g., high versus low gradient streams), failure to address key habitat variables (e.g., adding instream cover without addressing temperature extremes), pool filling, poor riparian tree survival, and bank erosion due to incorrect installation of boulders or large woody debris (Moerke and Lamberti 2004; Moerke et al. 2004; Pretty et al. 2003; Rabeni and Sowa 1996; Shields et al. 1998). Even in cases where stream habitat and aquatic communities are improved over pre-restoration conditions, they may not be restored to pre-disturbance conditions (e.g., pre-dredging). Also, any efforts to restore instream habitat quality would harm riparian habitat, due to the need to access the creek with heavy equipment (Section 4.2.1).

4.2.2.2 Biological Community

As stated previously, dredging would effectively remove the entire benthic invertebrate community in Reach 2. The rate of recovery would depend on the quality of the aquatic habitat, which would be substantially modified from pre-dredging conditions. Physical habitat degradation and simplification were cited as the primary factors influencing macroinvertebrate recovery in stream systems (Niemi, DeVore et al. 1990; Wallace 1990). In a review of 150 case studies of stream recovery, stressors such as channelization and watershed disturbances produced consistently longer recovery times for macroinvertebrates; recovery times for some parameters evaluated (e.g., density, species composition) exceeded 18 years (Niemi, DeVore et al. 1990). In contrast, Niemi, DeVore et al. (1990) determined that macroinvertebrates tend to recovery relatively quickly (e.g., less than 18 months) from single events which do not substantially alter the physical habitat, such as toxic releases and floods.

The rate of recovery for the biological community in Reach 2 would also depend on the sources and mechanisms of repopulation of the affected areas. For example, in marine systems, repopulation may occur within days post-dredging due to influx of macroinvertebrates from adjacent, unaffected areas (McCauley, Parr et al. 1977). There are several mechanisms of repopulation for freshwater streams, including (1) downstream drift from upstream, unaffected areas; (2) aerial repopulation by insect adults; (3) migration from the deeper hyporheic zone to surface substrates; and (4) upstream migration. Of these mechanisms, downstream drift and aerial repopulation have been shown to be the most effective in stream repopulation (Williams and Hynes 1976). Therefore, the distance and quality of upstream sources of macroinvertebrates become important factors. Niemi, DeVore et al. (1990) presents several case studies in which the rate at which species density and composition recovered in freshwater streams was dependent on the distance from the source of macroinvertebrates. Since

Reach 2 is approximately 3 kilometers in length, it may take considerable time for macroinvertebrates to repopulate the downstream portions of the reach. For comparison, a 7.2 kilometer stretch of a stream in Montana required 17 months to recover from DDT exposure, whereas the upstream portions of the stream reached recovery much more quickly (Schoenthal 1963). Furthermore, macroinvertebrate community quality upstream is much lower than in Reach 2, because of poor habitat quality associated with extensive channelization. The lack of a high-quality upstream source for recolonization would considerably slow the recovery of the invertebrate community in Reach 2.

Although some macroinvertebrates may repopulate an area relatively quickly, it may take considerably longer to establish a functional community similar to the pre-dredging status. Initially, more tolerant and mobile species will populate "disturbed" environments. The abundance (i.e., number of individuals) of these species may reach pre-dredge levels within a short time period. However, establishment of species diversity (i.e., the number of different species) requires a much longer recovery period. For instance, mayflies and true flies have the highest recovery rates, whereas mollusks are among the last taxa to recover from disturbances involving removal of species from the stream (Wallace 1990). Facilitation of faunal recruitment in restored wetlands, through the placement of vegetation/sediment plugs from natural wetlands, has been successfully attempted (Brady et al. 2002), but we found no evidence of this practice in the stream restoration literature.

Although dredging would directly remove only some smaller fish from Reach 2, the physical disturbance and loss of food sources would adversely affect the entire fish community. Similar to invertebrates, fish communities are generally resilient to short-term disturbances but are not resilient to long-term disturbances that affect physical habitat quality (Detenbeck, DeVore et al. 1992). Because fish are more mobile than many benthic invertebrates, recolonization from downstream areas would be expected to enhance recovery, despite the limited utility of upstream areas as a recolonization source. In a review of 49 case studies, Detenbeck, DeVore et al. (1992) found that overall fish species richness and abundance typically recovered from short-term impacts in less than a year, although more than two years were usually required for recovery of the least resilient species. Because the recovery of biological communities is dependent on the recovery of the physical habitat, it is possible that the biological community will remain permanently altered (Wallace 1990).

4.2.3 Potential Contaminant Losses

Minimization of sediment resuspension would be a key concern in the selection of dredging equipment and methods for Reach 2. However, all dredges resuspend some sediment during the dredging process, resulting in the transport of contaminants away from the dredging site (Palermo et al. 1998). As a result, PCB levels in fish would be expected to show at least a short-term increase in and downstream of Reach 2 after dredging. Sediment resuspension may also contribute to long-term failure to reduce PCB bioaccumulation, as discussed in Section 5.2. As described previously, both the in situ stabilization and dredging alternatives would cause sediment resuspension. However, dredging would be expected to cause more extensive resuspension, because the entire sediment bed would be dislodged and removed.

Another pathway of potential contaminant loss is volatilization. Although PCBs are considered environmentally persistent, experimental data indicate that lower chlorinated PCBs are highly susceptible to volatilization during co-evaporation with water (Chiarenzelli et al. 1998). On a local scale, this phenomenon raises issues with respect to exposure of remediation workers and neighbors. On a global scale, transport of PCBs through the atmosphere has led to elevated concentrations as far from contaminant sources as the Arctic (e.g., MacDonald et al. 2000). Similar to sediment resuspension, measures may be adopted to control the extent to which contaminated sediments are exposed to the air, but PCB volatilization may not be entirely eliminated.

Finally, there is some potential for spills of contaminated material during dredging, treatment, and disposal.

4.2.4 Societal Impacts

Off-site disposal of 12,000 tons of sediment would entail the transport of 450 to 500 dump trailer loads. If smaller dump trucks were used, many more loads would be required. Also, transportation of stream restoration materials (gravel, trees, etc.) would entail many additional truck loads. Local traffic impacts, fuel usage, and air emissions (diesel exhaust) would be significant. Some additional solid waste would also be generated in the form of water treatment filters etc. Land use in the vicinity of the waste disposal area would also be affected in the long term, as the large volume of disposed waste would hasten the need for landfill expansion.

Because of the increase in truck traffic (on top of that associated with dredging of Reach 1), implementation of dredging would increase the risk of traffic accidents in the surrounding area. Worker injuries during dredging are also a risk, due to the need to operate heavy equipment in a difficult physical environment.

As discussed previously, the construction of staging areas in wooded habitat should be avoided due to the severe environmental impact. However, the construction of staging areas in farm fields (e.g., areas 4 and 5, Figure 2) is likely to decrease the agricultural productivity of the land, even after the staging area is removed. Soil compaction would be the primary adverse effect. Other possible staging area locations shown in Figure 2 would be disruptive due to their close proximity to residences and the Amanda School. It is very unlikely that any staging areas could be constructed near Reach 2 without significant environmental or societal impacts.

The short- and long-term aesthetic impacts of tree removal would also be substantial. Foot paths are evident in the wooded riparian zone along Reach 2, indicating that the area is used for recreation (e.g., nature walks). Dredging would adversely affect the recreational value of the riparian area.

5. Environmental Benefits of Remedial Alternatives

Comprehensive risk assessments have identified no significant risks to human health or ecological receptors in Dick's Creek (ARCADIS 2004a,b). Nevertheless, remedial actions have been proposed to lower the concentrations of PCBs in fish tissue. Therefore, the environmental benefits of alternative remedial technologies are discussed here in terms of their likely success in decreasing PCB bioavailability and bioaccumulation.

5.1 In Situ Sequestration

Laboratory tests have shown that the addition of activated carbon to contaminated sediment can reduce the bioaccumulation of organic compounds by 70-90% (Luthy 2003; 2004; Werner et al. 2004; Zimmerman et al. 2004). The greatest reductions in bioaccumulation were associated with the longest equilibration times. Thus, up to an order of magnitude reduction in fish tissue concentrations may be achievable using this technology. However, in a field application, it will be more challenging to mix the activated carbon with the sediment, as compared to a laboratory setting. Therefore, a decrease in fish tissue PCB concentrations of 70% would be considered successful.

The reduction in PCB bioavailability and bioaccumulation would be a long-term benefit. It is well established that the sorption of hydrophobic organic compounds to organic carbon increases in strength over time, until the "slow" or "irreversibly" sorbing fraction eventually reaches equilibrium (e.g., Cornelissen et al. 1997; Hwang and Cutright 2002; Kan et al. 1998; Kukkonen and Landrum 1998; Leppanen and Kukkonen 2000; Pignatello and Xing 1996; Reid et al. 2000). The reverse process, namely long-term declines in sorption strength over time, has not been observed. Because activated carbon is extremely stable under environmentally relevant conditions (similar to coal or charcoal), there is every reason to expect that in situ sequestration of PCBs with activated carbon would be permanent.

5.2 Dredging

Removal of contaminated sediment has intuitive appeal: if PCBs are removed, they should no longer bioaccumulate in fish. However, the reality of dredging is not so simple, because no removal technology can remove every particle of contaminated sediment. Dredging is most successful in soft-bottom systems where over-dredging can be accomplished. Residual contamination is likely to be higher in the presence of cobbles, boulders, or buried debris, in high energy environments, at greater water depths, and where contaminated sediment directly overlies bedrock or a hard bottom (USEPA 2002b). Reach 2 of Dick's Creek is not primarily a depositional environment, as evidenced by the abundance of riffle habitat (see Appendix A). Gravel and cobble substrate is prevalent in riffle areas, which would tend to decrease the effectiveness of dredging.

There are well-documented cases in which the mass removal of contaminated sediments failed to achieve a reduction in contaminant bioavailability and bioaccumulation. After the removal of DDT-contaminated sediment from the Lauritzen Canal in San Francisco Bay, the surface sediment was rapidly recontaminated by material that had been left in place below docks and pilings. Numerous indicators showed an increase in toxicity and bioaccumulation approximately 16 months after dredging, and little improvement was observed even 4 years after dredging (Weston et al. 2002).

Voie et al. (2002) describe a dredging project in Norway in which sediment concentrations of PCBs were reduced by 90 percent, yet the concentrations in caged mussels increased 7 months after dredging. The only identified source of potential recontamination was the settling of fine contaminated particles that had been resuspended during the dredging operation. A decrease in the sorption capacity of the sediment due to the removal of fine organic-rich material was also postulated (Voie et al. 2002).

Sediment dredging in Waukegan Harbor, Illinois was partially successful in addressing sediment toxicity. Four years after dredging, sediment samples caused sublethal toxicity in amphipods, whereas the sediment was lethal to amphipods prior to dredging (Kemble et al. 2000). The Black River provides an example of severe short-term impacts of dredging followed by long-term improvement. After the closure of a coke plant, PAH levels in sediment and liver tumors in fish declined precipitously, but re-contamination during dredging resulted in tumor levels even higher than those observed prior to natural recovery. Four years after dredging, however, liver tumors were entirely absent in 3-year-old fish, although older fish continued to exhibit tumors (Baumann and Harshbarger 1998). Given the previous evidence of natural recovery in this system, it is unclear whether the improvement in fish condition was due to dredging, natural recovery, or both.

As these case studies illustrate, the ability of sediment dredging to reduce chemical bioavailability and bioaccumulation is highly uncertain. The physical characteristics of Dick's Creek suggest that dredging has a higher likelihood of success in Reach 1 than in Reach 2. Whereas Reach 1 is characterized by relatively homogeneous, sandy sediment, Reach 2 contains many high-energy riffles with a much coarser substrate. There is a substantial risk that dredging in Reach 2 would achieve less environmental benefit than the in situ sequestration alternative.

6. Conclusions

Reach 2 of Dick's Creek is characterized by primarily good quality aquatic and riparian habitat, and fish and invertebrate community quality in this area meets the Ohio EPA's criteria. Dredging in this area would have profound short- and long-term impacts on the habitat and biological communities. Recovery would take years to decades, and full recovery of the biological community might not even be possible depending on the extent of long-term habitat impacts. Furthermore, the effectiveness of dredging in controlling PCB bioaccumulation in fish is highly uncertain.

In contrast, in situ sequestration by activated carbon addition would have few environmental side-effects. This technology is extremely promising based on laboratory studies and is expected to be effective in the field.

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TABLES

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Table 1. Riparian and Aquatic Plant Species Observed in Reach 2
Dick's Creek, Middletown, Ohio

Scientific Name	Common Name	Dominant	Native	Invasive	Aggressive	Growth	Habit
Tree							
Acer negundo	Box elder	yes	yes	no	yes	deciduous	single
Acer saccharum	Maple	no	yes	no	no	deciduous	single
Aesculus glabra	Ohio buckeye	no	yes	no	no	deciduous	single
Carpinus caroliniana	Musclewood	no	yes	no	no	deciduous	single
Catalpa bignonioides	Catalpa	no	yes	no	no	deciduous	single
Celtis occidentalis	Hackberry	common	yes	no	no	deciduous	single
Crataegus sp.	Hawthorne	common	yes	no	no	deciduous	single
Diospyros virginiana	Persimmon	no	yes	no	no	deciduous	single
Juglans nigra	Black walnut	no	yes	no	no	deciduous	single
Maclura pomifera	Osage orange	common	yes	no	no	deciduous	single
Morus alba	Mulberry	no	yes	no	no	deciduous	single
Nyssa sylvatica	Blackgum	no	yes	no	no	deciduous	single
Platanus occidentalis	Sycamore	yes	yes	no	no	deciduous	single
Populus deltoides	Cottonwood	no	yes	no	no	deciduous	single
Prunus serotina	Black cherry	no	yes	no	yes	deciduous	single
Quercus sp.	Oak	no	yes	no	no	deciduous	single
Rhus glabra	Smooth sumac	no	yes	no	no	deciduous	colonial
Robinia pseudoacacia	Black locust	no	yes	no	yes	deciduous	single
Ulmus americana	American elm	yes	yes	no	yes	deciduous	single
Shrubs							
Ligustrum vulgare	Privet	no	no	yes	no	deciduous	colonial
Lonicera maackii	Amur honeysuckle	yes	no	yes	yes	annual	single
Rosa multiflora	Multiflora rose	no	no	yes	yes	deciduous	colonial
Viburnum acerifolium	Maple-leaf viburnum	no	yes	no	no	annual	single
Herbaceous Plants							
Abutilon theophrasti	Indian mallow	no	no	no	no	annual	single, clump
Alliaria petiolata	Garlic mustard	common	no	yes	yes	biennial	colonial
Ambrosia artemisiifolia	Ragweed	common	yes	no	yes	annual	single
Boehmeria cylindrica	False nettle	yes	yes	no	no	perennial	single
Commelina communis	Common dayflower	no	no	no	no	annual	single

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Table 1. Riparian and Aquatic Plant Species Observed in Reach 2
Dick's Creek, Middletown, Ohio

Scientific Name	Common Name	Dominant	Native	Invasive	Aggressive	Growth	Habit
Herbaceous Plants continued							
Dipsacus sylvestris	Teasel	common	no	yes	yes	biennial, perennial	colonial
Eupatorium sp.	Joe Pye weed & bonesets	yes	yes	no	no	perennial	single
Helianthus decapetalus	Forest sunflower	yes	yes	no	no	perennial	single
Hesperis matronalis	Dames rocket	no	no	no	yes	biennial	single
Impatiens pallida	Pale touch-me-not	common	no	no	no	annual	single
Lobelia siphilitica	Great blue lobelia	no	yes	no	no	perennial	single
Mentha arvensis	Field mint	no	yes	no	no	perennial	single
Phtyolacca americana	Pokeweed	common	yes	yes	yes	perennial	colonial
Pilea pumila	Clearweed	yes	yes	no	no	annual	single
Rudbeckia laciniata	Green-headed coneflower	yes	yes	no	no	perennial	single
Verbena hastata	Blue vervain	no	yes	no	no	perennial	single
Verbesina alternifolia	Wingstem	yes	yes	no	no	perennial	single
Groundcovers/Vines							
Bromus spp.	Brome grass	common	na	na	no	annual	rhizome, colonial
Euonymus fortunei	Winter creeper	no	no	no	medium	evergreen	woody climbing vine
Humulus japonicus	Japanese hops	yes	no	yes	yes	annual	herb twining vine
Juncus spp.	Rush	no	yes	no	no	annual	clump
Panicum spp.	Panic grass	yes	na	na	no	annual	rhizome, colonial
Parthenocissus quinquefolia	Virginia creeper	common	yes	no	yes	annual	woody climbing vine
Polygonum spp.	Smartweed	no	yes	no	no	annual	single, clump
Rhus radicans	Poison ivy	yes	yes	yes	yes	annual, deciduous	woody climbing vine
Rubus allegheniensis	Blackberry	no	yes	yes	yes	perennial	herb twining vine
Smilax spp.	Greenbrier	no	yes	yes	yes	annual	woody twining vine
Solidago spp.	Goldenrod	yes	yes	yes	yes	annual	rhizome, single, clump
Vitis aestivalis	Summer grape	common	yes	yes	yes	annual, deciduous	woody climbing vine
Aquatic Plants							
Elodea canadensis	Common water-weed	no	yes	no	no	perennial	single
Potamogeton crispus	Curly pondweed	yes	no	no	no	annual	rhizome

Table 2. Qualitative Habitat Evaluation Index Summary for Reach 2
Dick's Creek, Middletown, Ohio

Location	Qualitative Habitat Evaluation Index			Qualitative Rating	Comments
	2000[a]	2001[b]	2004[c]		
Area A (downstream of Yankee Road overpass).	--	--	38	poor	Channelized (poor channel morphology), sparse instream cover, riffle habitat lacking, limited riparian cover, poor substrate
Area B (upstream end of non-channelized area)	--	--	59.5	good	Good channel morphology and instream cover, moderate riparian zone width, functional riffle habitat, moderate to extensive siltation/embeddedness
Area C (just downstream of unnamed tributary confluence)	--	--	65.5	good	Excellent channel morphology, good instream cover, wide riparian zone (north bank only), functional pool, riffle and run habitats, moderate to extensive siltation/embeddedness
Area D (behind Amanda School)	68.5	71	69.5	good	Excellent channel morphology and instream cover, moderate to good riparian zone, high quality pools but moderate to extensive siltation/embeddedness of riffles
Area E (between rail overpass and Amanda School)	--	--	47	fair	Good channel morphology, moderate instream cover, wide riparian zone (south bank only), riffle habitat lacking, moderate to extensive siltation/embeddedness
Area F (upstream of Main Street overpass)	44.5	--	45	fair	Channelized (poor channel morphology), sparse to no instream cover, poor riparian cover, pool, riffle and run habitats present

a. Evaluation performed by Ohio Environmental Protection Agency (Ohio EPA) during July 2000.
b. Evaluation performed by EA Engineering, Science, and Technology, Inc. during September 2001.
c. Evaluation performed by ARCADIS during August 2004.

-- not evaluated

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Table 3. Fish Species Observed in Reach 2
Dick's Creek, Middletown, Ohio

Common Name	Scientific Name	2000[a] Number of Fish Collected	2000[a] Percent of Total	2001[b] Number of Fish Collected	2001[b] Percent of Total	2001[c] Population Estimate[d]	2001[c] Percent of Total Large Fish
Cyprinidae (carps and minnows)							
Central Stoneroller	*Campostoma anomalum*	44	10%	1	0.6%		
Common carp	*Cyprinus carpio*	3	0.7%	5	3%	116	4%
Creek chub	*Semotilus atromaculatus*	19	4%	1	0.6%		
Striped shiner	*Luxilus chrysocephalus*	5	1%				
Spotfin shiner	*Cyprinella spiloptera*	14	3%	2	1%		
Sand shiner	*Notropis stramineus*	34	7%	15	9%		
Silver shiner	*Notropis photogenus*	1	0.2%				
Rosyface shiner	*Notropis rubellus*	2	0.4%				
Suckermouth minnow	*Phenacobius mirabilis*	27	6%	7	4%		
Bluntnose minnow	*Pimephales notatus*	57	12%	13	8%		
Fathead minnow	*Pimephales promelas*	2	0.4%				
Catostomidae (suckers)							
White sucker	*Catostomus commersoni*	36	8%	3	2%	391	14%
Northern hogsucker	*Hypentelium nigricans*	1	0.2%	1	0.6%		
Golden redhorse	*Moxostoma erythrurum*	20	4%	36	22%	1,897	67%
Black redhorse	*Moxostoma duquesnei*			3	2%	14	0.5%
Ictaluridae (catfish)							
Yellow bullhead	*Ameiurus natalis*	2	0.4%	2	1%	29	1%
Channel catfish	*Ictalurus punctatus*	9	2%	6	4%	261	9%

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Table 3. Fish Species Observed in Reach 2
Dick's Creek, Middletown, Ohio

Common Name	Scientific Name	2000[a] Number of Fish Collected	2000[a] Percent of Total	2001[b] Number of Fish Collected	2001[b] Percent of Total	2001[c] Population Estimate[d]	2001[c] Percent of Total Large Fish
Centrarchidae (black basses, crappies, sunfishes)							
Rock bass	*Ambloplites rupestris*	2	0.4%	1	0.6%	29	1%
Green sunfish	*Lepomis cyanellus*	62	13%	6	4%		
Longear sunfish	*Lepomis megalotis*	110	24%	45	28%		
Bluegill	*Lepomis macrochirus*			6	4%		
Smallmouth bass	*Micropterus dolomieu*	3	0.7%	1	0.6%	87	3%
Largemouth bass	*Micropterus salmoides*	2	0.4%	4	2%		
Percidae (walleye, perch, darters)							
Greenside darter	*Etheostoma blennioides*	4	0.9%	1	0.6%		
Johnny darter	*Etheostoma nigrum*	1	0.2%	1	0.6%		
Orangethroat darter	*Etheostoma spectabile*			2	1%		
Logperch	*Percina caprodes*	1	0.2%				
Index of Biotic Integrity (IBI)		33		42		NA	
Modified Index of Well-Being (IWB)		7.8		7.8		NA	

a. Fish collected by Ohio EPA (2000).
b. Fish collected by EA Engineering (2001a).
c. Fish collected by EA Engineering (2001b).
d. This value is the estimate of the fish population for the stretch of Dick's Creek between the unnamed tributary and Route 4.

Table 4. Benthic Invertebrate species Observed in Reach 2
Dick's Creek, Middletown, Ohio

Scientific Name	Common Name	2000[a] Quantitative	2000[a] Qualitative	2001[b] Quantitative	2001[b] Qualitative
Turbellaria	Flatworms		+		
Oligochaeta	Annelids	1	+	1	+
Helobdella triserialis	Leech		+		
Mooreobdella microstoma	Leech		+		+
Lirceus	Aquatic Isopods				+
Crangonyx	Amphipod				+
Orconectes (Procericambarus) rusticus	Crayfish		+		+
Hydracarina	Water Mites	2	+		
Baetis intercalaris	Mayflies	83	+	65	+
Callibaetis sp.	Mayflies		+		+
Leucrocuta sp.	Mayflies		+		+
Tricorythodes sp.	Mayflies	10	+	71	+
Caenis sp.	Mayflies	1	+	2	+
Anthopotamus sp.	Mayflies		+		+
Isonychia	Mayflies			97	+
Stenonema terminatum	Mayflies			2	+
Calopteryx sp.	Damselflies/Dragonflies		+		10
Coenagrionidae	Damselflies/Dragonflies		+		
Argia sp.	Damselflies/Dragonflies	41	+	24	+
Macromia sp.	Damselflies/Dragonflies		+		+
Enallagma	Damselflies/Dragonflies				+
Corixidae	Boatmen		+		
Rheumatobates	Water Strider				+
Rhagovelia	Broad-shouldered water striders				+
Sialis sp.	Alderflies		+		
Corydalus cornutus	Dobsonflies		+	1	
Cheumatopsyche sp.	Caddisflies	449	+	95	+
Ceratopsyche morosa group	Caddisflies	13			+
Hydropsyche depravata group	Caddisflies	33	+	3	+
Hydroptila sp.	Caddisflies		+		+
Peltodytes sp.	Crawling water beetles		+		
Berosus sp.	Water Scavenger Beetles		+		+
Dubiraphia vittata group	Riffle beetles		+		
Stenelmis sp.	Riffle beetles	1	+		+
Gyrinus sp.	Small whirligig beetles				+
Ceratopogonidae	No-See-Ums/Biting Midges		+		
Ablabesmyia mallochi	Aquatic Midge		+		+
Chironomidae	Midge			112	
Chironomus sp.	Midge				+
Chironomus (C.) decorus group	Midge		+		
Conchapelopia sp.	Midge		+		
Corynoneura lobata	Midge	10			
Cricotopus (C.) sp.	Midge	379			
Cricotopus (C.) bicinctus	Midge	207	+	224	+
Cricotopus (C.) tremulus group	Midge	103	+		
Cricotopus (Isocladius) sylvestris group	Midge	17			
Cryptochironomus sp.	Midge		+		+
Dicrotendipes neomodestus	Midge		+	16	+

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Table 4. Benthic Invertebrate species Observed in Reach 2
Dick's Creek, Middletown, Ohio

Scientific Name	Common Name	2000[a] Quantitative	2000[a] Qualitative	2001[b] Quantitative	2001[b] Qualitative
Dicrotendipes simpsoni	Midge	34			
Glypototendipes (G.) sp.	Midge		+	96	
Hayesomyia senata	Midge	155	+		
Larsia sp.	Midge		+		
Nanocladius (N.) distinctus	Midge	17	+	176	
Nanocladius (N.) minimus	Midge	52	+		
Nilotanypus fimbriatus	Midge	8	+	32	
Parachironomus sp.	Midge	17			
Parametriocnemus	Midge			16	
Paratanytarsus sp.	Midge	34	+	96	+
Polypedilum (P.) fallax group	Midge		+		
Polypedilum (P.) illinoense	Midge	86	+	32	+
Polypedilum (Tripodura) halterale group	Midge		+		
Polypedilum (Tripodura) scalaenum group	Midge	69	+	16	+
Polypedilum flavum	Midge			32	+
Procladius (Holotanypus) sp.	Midge		+		
Pseudochironomus sp.	Midge				+
Rheotanytarsus sp.	Midge			432	+
Rheotanytarsus exiguus group	Midge	293	+		
Tanypus neopunctipennis	Midge		+		
Tanytarsus glabrescens group sp. 7	Midge	17		176	+
Tanytarsus guerius grp.	Midge			16	+
Thienemanniella xena	Midge	8	+	256	
Thienemannimyia grp.	Midge			240	+
Hemerodromia sp.	Shore/Brine Flies	8	+	38	+
Anopheles spp.	Mosquitoes				+
Physella sp.	Tadpole Snail		+	1	+
Ferrissia sp.	Freshwater Limpet	2	+	3	+
Corbicula fluminea	Asian Clam	3	+	4	+
Musculium sp.	Fingernail Clam				+
Pisidium sp.	Pea Cockle		+		
Sphaerium sp.	Pea Clam		+		
Total Number of Taxa		62		52	
Total Number of Organisms		2153		2375	
Invertebrate Community Index (ICI)		34		32	
Qualitative EPT Taxa		9		12	

a. Ohio EPA (2000)
b. EA Engineering (2002)

FIGURES

FIGURES

Figure 1
Site Map
Reach 2
Dick's Creek
Middletown, Ohio

Legend

- ▲ Qualitative Habitat Evaluation Index (QHEI) Locations
- Stream
- Roads

Aerial Photograph purchased from IntraSearch Inc. Image is a 2003, .61 meter, full color aerial photograph georectified to UTM Zone 16N NAD83 Meters. Positions may vary in accuracy due to scale differences between the data sets. Spatial information is meant for general reference only.

Base Data are projected to: Lambert Conformal Conic projection, 1983 North American Datum, Local coordinate grid State Plane Ohio (south) FIPS 3402.

Cartography by ARCADIS - Greenville, SC

N

ARCADIS

0 0.03 0.06 0.12 0.18 0.24 Miles

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Figure 2
Conceptual Diagram for Dredging Alternative
Reach 2
Dick's Creek
Middletown, Ohio

Impacted Land Use

Agricultural - 3.8 acres
Commercial/Industrial/Public - 2 acres
Deciduous Woodland - 1.8 acres
Other Open Land - 2.9 acres
Residential - 0.5 acres

Total Land Use Impact - 11 acres
(All acreage calculations are estimates)

Legend

- Staging Areas
- Turnaround Areas
- 1 Lane Roads
- 2 Lane Roads
- Roads

Aerial Photograph purchased from IntraSearch Inc. Image is a 2003, .61 meter, full color aerial photograph georectified to UTM Zone 16N NAD83 Meters. Positions may vary in accuracy due to scale differences between the data sets. Spatial information is meant for general reference only.

Base Data are projected to: Lambert Conformal Conic projection, 1983 North American Datum, Local coordinate grid State Plane Ohio (south) FIPS 3402.

Cartography by ARCADIS - Greenville, SC

N

ARCADIS

0 0.03 0.06 0.12 0.18 0.24 Miles

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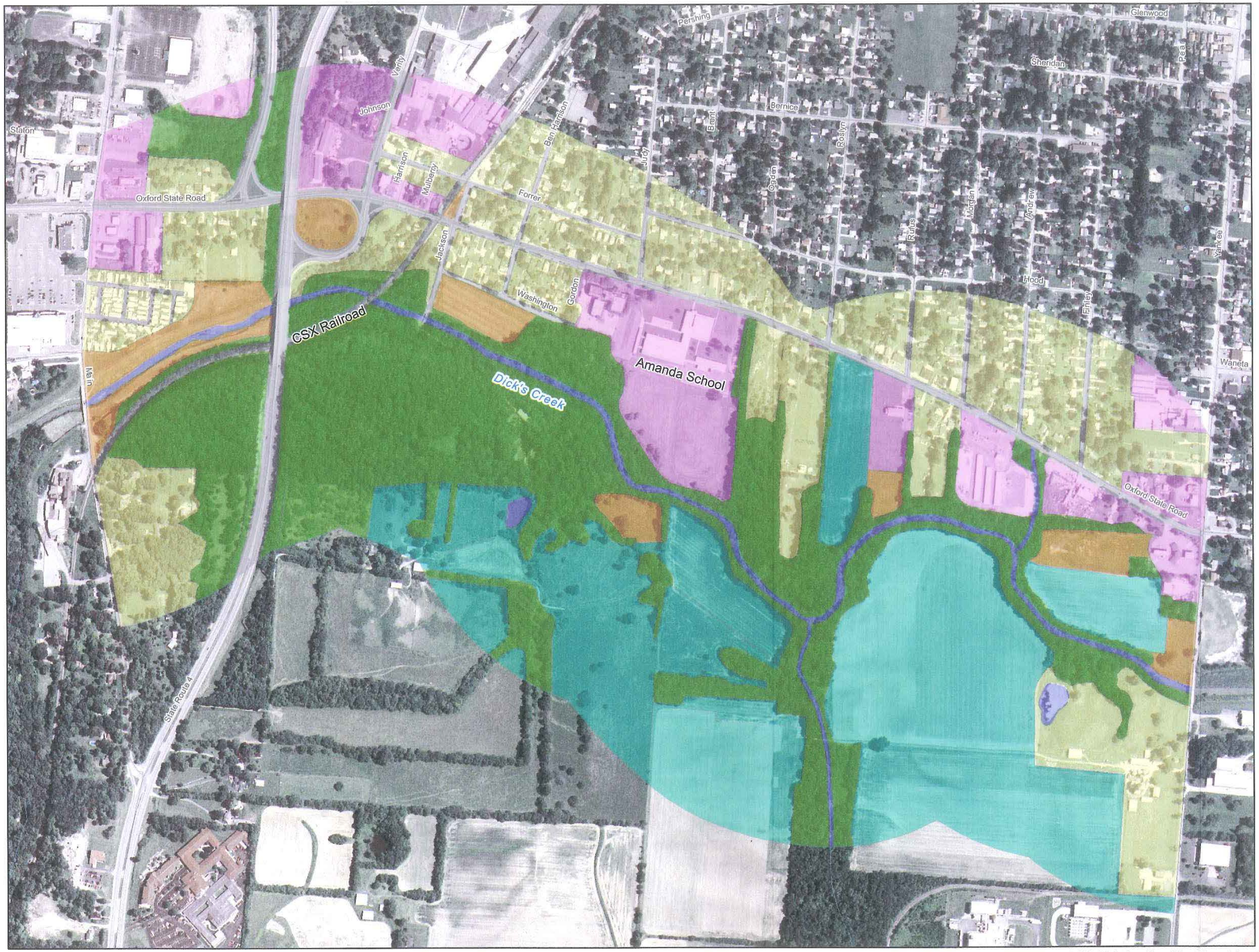

Figure 3
Land Use
Reach 2
Dick's Creek
Middletown, Ohio

Legend

Land Use

- Agricultural - 119 Acres
- Commercial/Industrial/Public - 59 Acres
- Deciduous Woodland - 123 Acres
- Other Open Land - 21 Acres
- Residential - 113 Acres
- Surface Water - 9.5 Acres
- Transportation Corridor - 28 Acres
- Roads

(All acreage calculations are estimates)

Aerial Photograph purchased from IntraSearch Inc. Image is a 2003, .61 meter, full color aerial photograph georectified to UTM Zone 16N NAD83 Meters. Positions may vary in accuracy due to scale differences between the data sets. Spatial information is meant for general reference only.

Base Data are projected to:
Lambert Conformal Conic projection, 1983 North American Datum, Local coordinate grid State Plane Ohio (south) FIPS 3402.

Cartography by ARCADIS - Greenville, SC

N

ARCADIS

0 0.03 0.06 0.12 0.18 0.24 Miles

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Figure 4
Non-channelized Landscape

Dick's Creek
Middletown, Ohio

Extensive canopy cover over creek

Gravel shoreline and wooded riparian zone

Low-lying floodplain

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Figure 5
Channelized Landscape
Dick's Creek
Middletown, Ohio

Mowed berm separates Excello Trailer Park from Dick's Creek near Main Street overpass

No riparian cover, low complexity of in stream habitat

Riparian vegetation includes grasses and Japanese hops *(Humulus japonicus)*, an exotic invasive species

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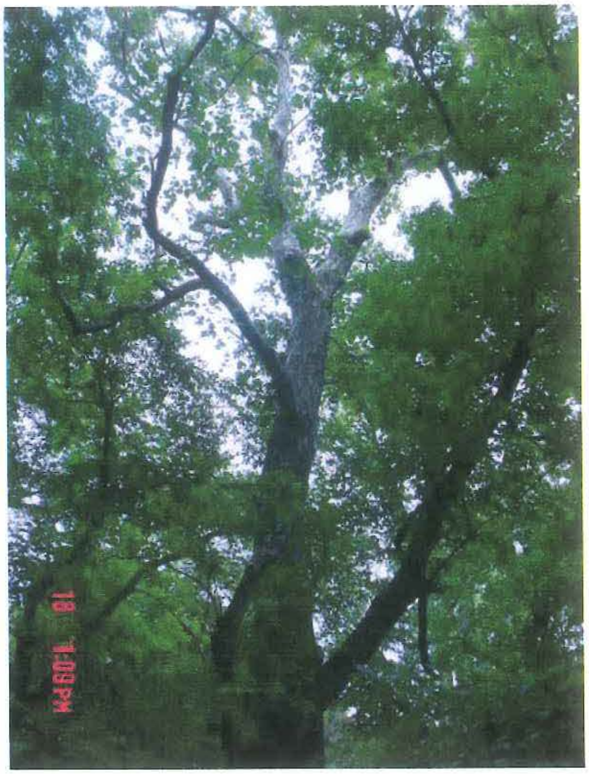
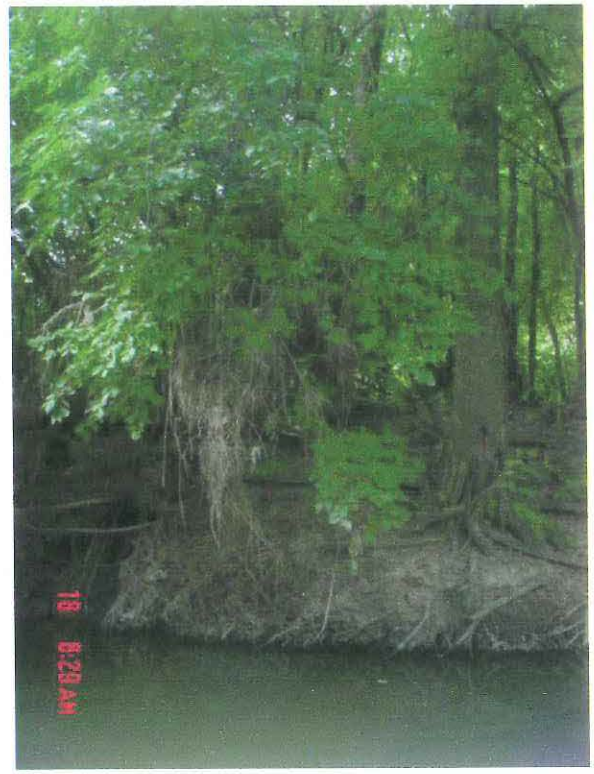
Figure 6
Riparian Trees,
Non-channelized Area

Dick's Creek
Middletown, Ohio



Large sycamore
(Platanus occidentalis)



Sycamore roots provide
bank stability and high
quality instream cover

Tree community

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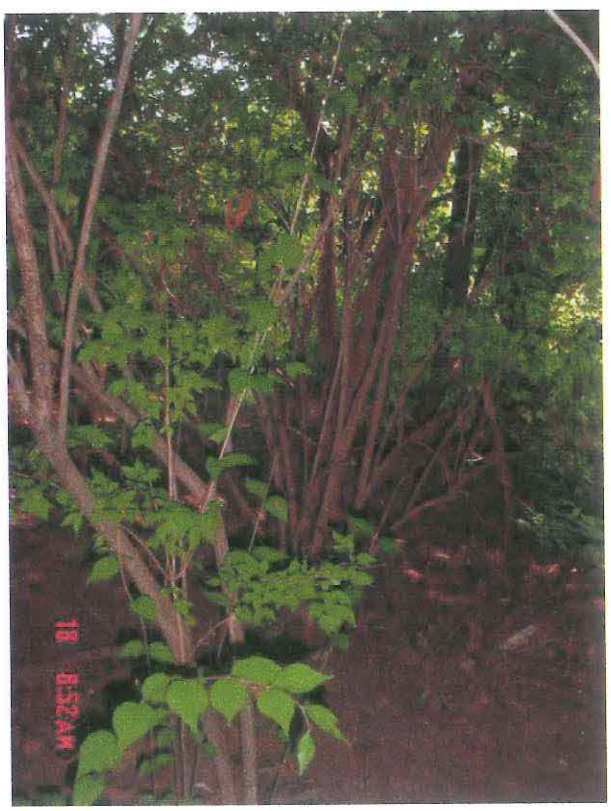
Figure 7
Exotic Invasive Vegetation

Dick's Creek
Middletown, Ohio

Amur honeysuckle
(Lonicera maackii)
Dominates the understory, displacing tree saplings and native shrubs



Dense understory of Amur honeysuckle

Wintercreeper *(Euonymus fortunei)*, an escaped ornamental groundcover

Figure 8
Native Herbaceous Vegetation
Dick's Creek
Middletown, Ohio

Great blue lobelia (*Lobelia syphilitica)* and Virginia creeper *(Parthenocissus quinquefolia),* on steep stream bank

Forest sunflower
(Helianthus decapetalus)

Clearweed
(Pilea pumila)

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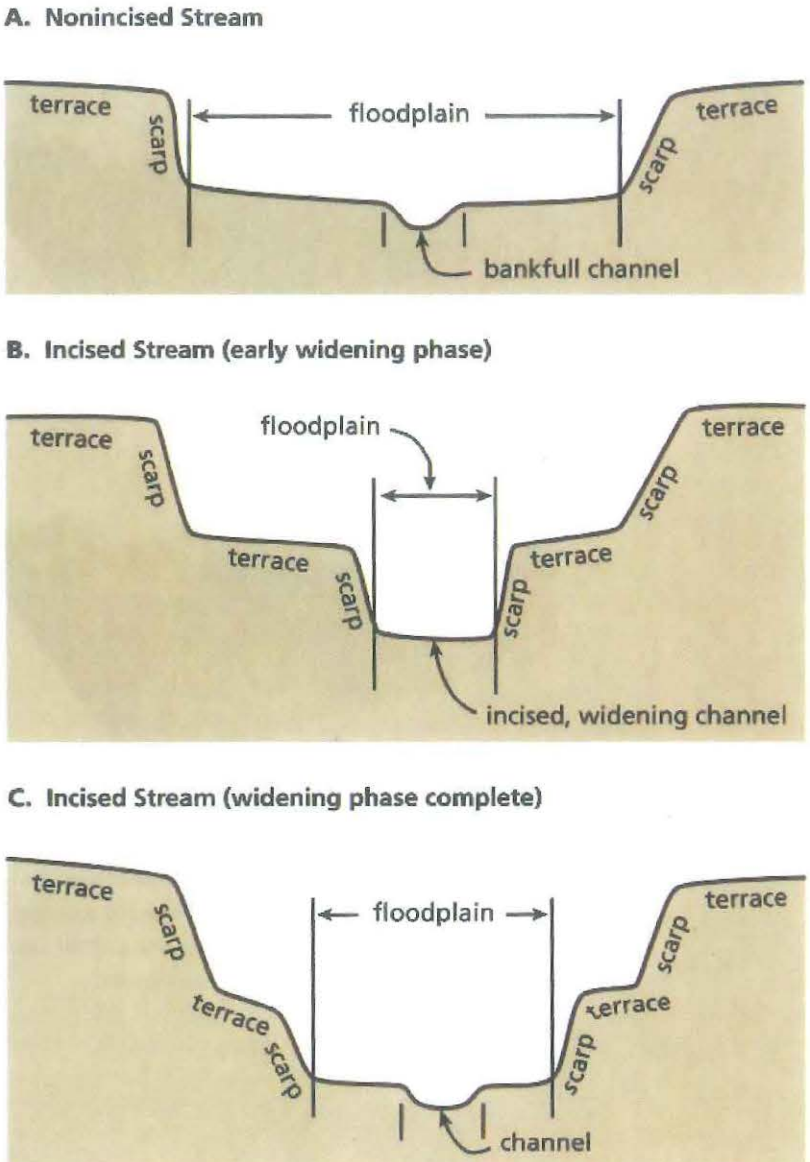
Figure 9
Aquatic Plants
Dick's Creek
Middletown, Ohio

Common water-weed
(Elodea canadensis)

Curly pondweed
(Potamogeton crispus),
an invasive aquatic species

Figure 10
Conceptual Model of Stream Incision
Dick's Creek, Middletown, Ohio



Source: Federal Interagency Stream Restoration Working Group (1998)

APPENDIX A

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Appendix A

Qualitative Habitat Evaluation Index (QHEI) Photographs and Field Sheets

ARCADIS

Appendix A
QHEI
AK Steel
Middletown, Ohio

QHEI Location A
(Note: pipe appears to be drain tile from farm field)

QHEI Location B

QHEI Location C

QHEI Location D

QHEI Location E

QHEI Location F

OhioEPA Qualitative Habitat Evaluation Index Field Sheet QHEI Score: 38

River Code:______ RM: ____ Stream Hicks Creek - A

Date 8-17-04 Location A

Scorers Initials: HMS / LAM Comments

1] SUBSTRATE (Check *ONLY* Two Substrate *TYPE BOXES; Estimate % present*);

TYPE	POOL RIFFLE		POOL RIFFLE	SUBSTRATE ORIGIN	SUBSTRATE QUALITY
☐☐-BLDR /SLBS[10]		☐☐-GRAVEL [7]		Check ONE (OR 2 & AVERAGE)	Check ONE (OR 2 & AVERAGE)
☐☐-BOULDER [9]		☐☑-SAND [6]	20	☐ -LIMESTONE [1]	SILT: ☐ -SILT HEAVY [-2]
☐☐-COBBLE [8]		☐☐-BEDROCK[5]		☐ -TILLS [1]	☑ -SILT MODERATE [-1]
☐☑-HARDPAN [4]	80	☐☐-DETRITUS[3]		☐ -WETLANDS[0]	☐ -SILT NORMAL [0]
☐☐-MUCK [2]		☐☐-ARTIFICIAL[0]		☑ -HARDPAN [0]	☐ -SILT FREE [1]
☐☐-SILT [2]				☐ -SANDSTONE [0]	EMBEDDEDNESS: ☐ -EXTENSIVE [-2]
				☐ -RIP/RAP [0]	☑ -MODERATE [-1]
				☐ -LACUSTRINE [0]	☐ -NORMAL [0]
				☐ -SHALE [-1]	☐ -NONE [1]
				☐ -COAL FINES [-2]	

oncreted

NOTE: (Ignore sludge originating from point-sources; score on natural substrates)

NUMBER OF SUBSTRATE TYPES: ☐-5 or More [2] ☑-4 or Less [0]

COMMENTS

Substrate **8** Max 20

2] INSTREAM COVER (see back for instructions for additional cover scoring method)

TYPE: (Check *All* That Apply)

☐ ___UNDERCUT BANKS [1] ☐ ___POOLS> 70 cm [2] ☐___OXBOWS, BACKWATERS [1]
☑___OVERHANGING VEGETATION [1] ☑___ROOTWADS [1] ☐___AQUATIC MACROPHYTES [1]
☐ ___SHALLOWS (IN SLOW WATER) [1] ☐ ___BOULDERS [1] ☐___LOGS OR WOODY DEBRIS [1]
☐ ___ROOTMATS [1] COMMENTS:

AMOUNT: (Check *ONLY* One or check 2 and *AVERAGE*)
☐ - EXTENSIVE > 75% [11]
☐ - MODERATE 25-75% [7]
☑ - SPARSE 5-25% [3]
☐ - NEARLY ABSENT < 5%[1]

Cover **5** Max 20

3] CHANNEL MORPHOLOGY: (Check *ONLY* One PER Category OR check 2 and *AVERAGE*)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY	MODIFICATIONS/OTHER	
☐ - HIGH [4]	☐ - EXCELLENT [7]	☐ - NONE [6]	☐ - HIGH [3]	☐ - SNAGGING	☐ - IMPOUND.
☐ - MODERATE [3]	☐ - GOOD [5]	☐ - RECOVERED [4]	☑ - MODERATE [2]	☐ - RELOCATION	☐ - ISLANDS
☑ - LOW [2]	☐ - FAIR [3]	☑ - RECOVERING [3]	☐ - LOW [1]	☑ - CANOPY REMOVAL	☐ - LEVEED
☐ - NONE [1]	☑ - POOR [1]	☐ - RECENT OR NO RECOVERY [1]		☑ - DREDGING	☐ - BANK SHAPING
				☐ - ONE SIDE CHANNEL MODIFICATIONS	

COMMENTS:

Channel **8** Max 20

4]. RIPARIAN ZONE AND BANK EROSION-(check ONE box per bank or check 2 and AVERAGE per bank) ★River Right Looking Downstream★

RIPARIAN WIDTH — L R (Per Bank)
☐☐ - WIDE > 50m [4]
☐☐ - MODERATE 10-50m [3]
☐☑ - NARROW 5-10 m [2]
☐☐ - VERY NARROW <5 m[1]
☑☐ - NONE [0]

FLOOD PLAIN QUALITY (*PAST 100 Meter RIPARIAN*) — L R (Most Predominant Per Bank)
☐☑ -FOREST, SWAMP [3]
☑☐ -SHRUB OR OLD FIELD [2] (US)
☑☐ -RESIDENTIAL, PARK, NEW FIELD [1]
☐☐ -FENCED PASTURE [1]
☐☐ -CONSERVATION TILLAGE [1]
☐☐ -URBAN OR INDUSTRIAL [0] (DS)
☑☑ -OPEN PASTURE, ROWCROP [0]
☐☐ -MINING/CONSTRUCTION [0]

BANK EROSION — L R (Per Bank)
☐☐ -NONE/LITTLE [3]
☑☑ -MODERATE [2]
☐☐ -HEAVY/SEVERE[1]

COMMENTS:

Riparian **5.5** Max 10 5

5.]POOL/GLIDE AND RIFFLE/RUN QUALITY

MAX. DEPTH (Check 1 ONLY!)
☐ - >1m [6]
☐ - 0.7-1m [4]
☑ - 0.4-0.7m [2]
☐ - 0.2-0.4m [1]
☐ - < 0.2m [POOL=0]

MORPHOLOGY (Check 1 or 2 & AVERAGE)
☐ -POOL WIDTH > RIFFLE WIDTH [2]
☑ -POOL WIDTH = RIFFLE WIDTH [1]
☑ -POOL WIDTH< RIFFLE W. [0]

CURRENT VELOCITY [POOLS & RIFFLES!] (Check *All* That Apply)
☐ -EDDIES[1] ☐ -TORRENTIAL[-1]
☐ -FAST[1] ☐ -INTERSTITIAL[-1]
☐ -MODERATE [1] ☐ -INTERMITTENT[-2]
☑ -SLOW [1]

COMMENTS:

Pool/Current **4** Max 12

CHECK ONE OR CHECK 2 AND AVERAGE

RIFFLE DEPTH
☐ - *Best Areas >10 cm [2]
☐ - Best Areas 5-10 cm[1]
☐ - Best Areas < 5 cm
☐ [RIFFLE=0]

RUN DEPTH
☑ - MAX > 50 [2] (US)
☐ - MAX < 50[1]

RIFFLE/RUN SUBSTRATE
☐-STABLE (e.g., Cobble, Boulder) [2]
☐-MOD. STABLE (e.g., Large Gravel) [1]
☐-UNSTABLE (Fine Gravel, Sand) [0]

RIFFLE/RUN EMBEDDEDNESS
☑ - NONE [2] (US)
☑ - LOW [1] (DS)
☐ - MODERATE [0]
☐ - EXTENSIVE [-1]

COMMENTS: ☐ - NO RIFFLE [Metric=0]

Riffle/Run **0** Max 8

Gradient **8** Max 10

6] GRADIENT (ft/mi): 5.62 DRAINAGE AREA (sq.mi.): 4.45 %POOL: ____ %GLIDE: 100 %RIFFLE: ____ %RUN: ____

*Best areas must be large enough to support a population of riffle-obligate fish species.

Is Sampling Reach Representative of the Stream (Y/N) ✓ If Not, Explain: ____

Subjective Rating (1-10)	Aesthetic Rating (1-10)
5	4

Gradient: ☐ - Low, ☐ - Moderate, ☐ - High

	Gear:	Distance:	Water Clarity:	Water Stage:	Canopy -% Open
First Sampling Pass					

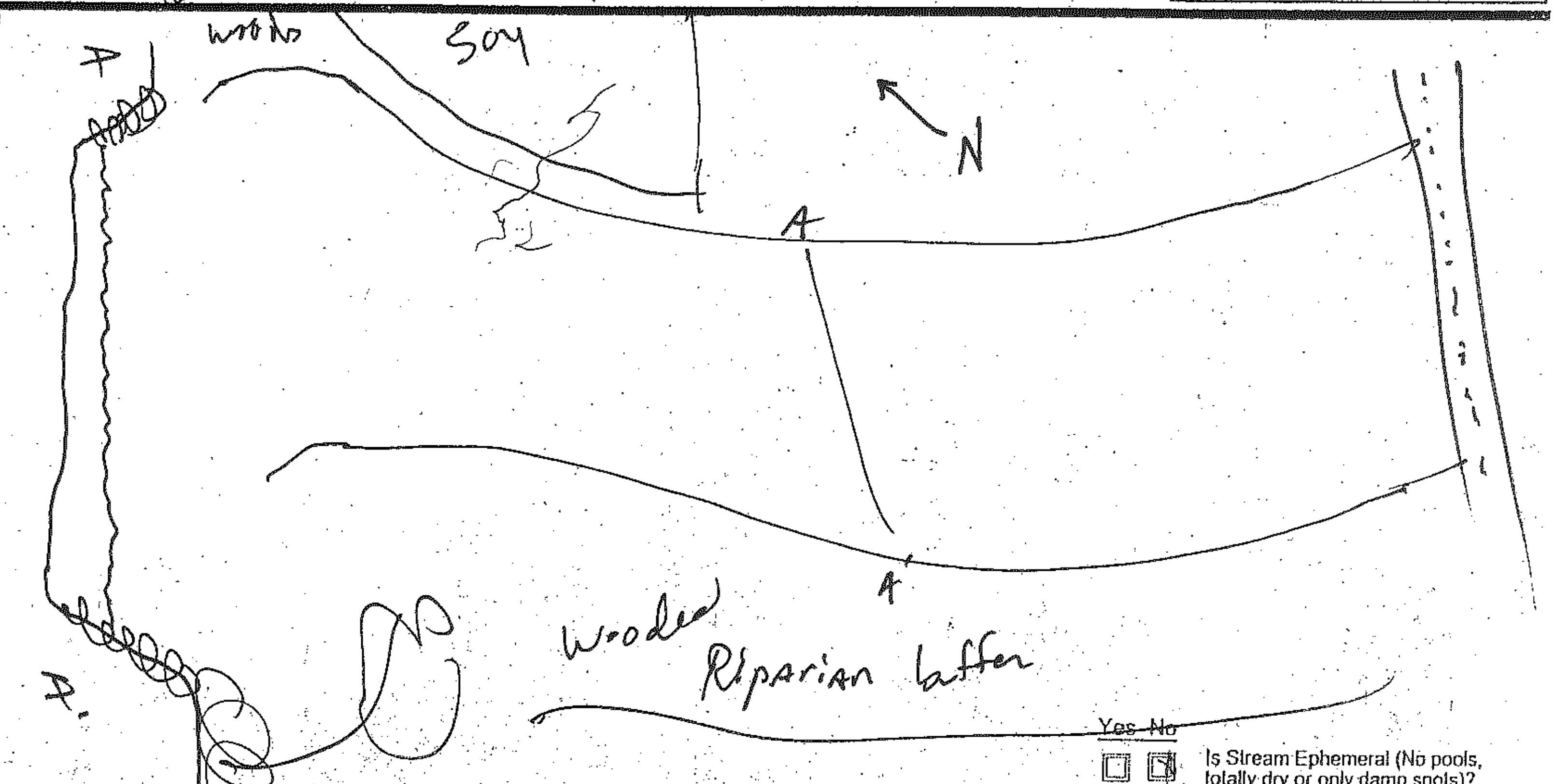
Stream Measurements:

Average Width	Average Depth	Maximum Depth	Av. Bankfull Width	Bankfull Mean Depth	W/D Ratio	Bankfull Max Depth	Floodprone Area Width	Entrench. Ratio
40	~~0-1.4~~ 16"	16"	40	6'		10'		

Major Suspected Sources of Impacts (Check All That Apply):
- None ☐
- Industrial ☒
- WWTP ☐
- Ag ☒
- Livestock ☐
- Silviculture ☐
- Construction ☐
- Urban Runoff ☒
- CSOs ☐
- Suburban Impacts ☐
- Mining ☐
- Channelization ☒
- Riparian Removal ☒
- Landfills ☐
- Natural ☐
- Dams ☐
- Other Flow Alteration ☐
- Other: ____ ☐

non

Stream Drawing:



Instructions for Scoring the Alternate Cover Metric: Each Cover Type Should Receive a Score of Between 0 and 3, Where: 0 - Cover type absent; 1 - Cover type present in very small amounts or if more common of marginal quality; 2 - Cover type present in moderate amounts, but not of highest quality or in small amounts of highest quality; 3 - Cover type of highest quality in moderate or greater amounts. Examples of highest quality cover include very large boulders in deep or fast water, large diameter logs that are stable, well developed rootwads in deep/fast water, or deep, well-defined, functional pools.

Yes	No	
☐	☒	Is Stream Ephemeral (No pools, totally dry or only damp spots)?
☒	☐	Is There Water Upstream? How Far: Miles
☒	☐	Is There Water Close Downstream? How Far: Mi
☐	✗	Is Dry Channel Mostly Natural?

OhioEPA Qualitative Habitat Evaluation Index Field Sheet QHEI Score: 59.5

River Code: ______ RM: ______ Stream ______
Date 8/17/04 Location DE-B
Scorers Initials: HMS, CAM Comments ______

1] SUBSTRATE (Check *ONLY* Two Substrate *TYPE BOXES; Estimate % present*);

TYPE POOL RIFFLE — POOL RIFFLE — SUBSTRATE ORIGIN — SUBSTRATE QUALITY

- ☐☐-BLDR /SLBS[10] ___ ___
- ☐☐-BOULDER [9] ___ ___
- ☐☐-COBBLE [8] ___ ___
- ☐☐-HARDPAN [4] ___ ___
- ☐☐-MUCK [2] ___ ___
- ☐☒-SILT [2] 60 20
- ☐☐-GRAVEL [7] ___ ___
- ☐☐-SAND [6] ___ ___
- ☐☒-BEDROCK[5] 40 80
- ☐☐-DETRITUS[3] ___ ___
- ☐☐-ARTIFICIAL[0] ___ ___

NOTE: (Ignore sludge originating from point-sources; score on natural substrates)
NUMBER OF SUBSTRATE TYPES: ☐-5 or More [2] ☒-4 or Less [0]
COMMENTS ______

Substrate Origin — Check ONE (OR 2 & AVERAGE): ☐-LIMESTONE [1] ☐-TILLS [1] ☐-WETLANDS[0] ☒-HARDPAN [0] ☐-SANDSTONE [0] ☐-RIP/RAP [0] ☐-LACUSTRINE [0] ☐-SHALE [-1] ☐-COAL FINES [-2]

Substrate Quality — Check ONE (OR 2 & AVERAGE):
SILT: ☐-SILT HEAVY [-2] ☒-SILT MODERATE [-1] ☐-SILT NORMAL [0] ☐-SILT FREE [1]
EMBEDDEDNESS: ☐-EXTENSIVE [-2] ☐-MODERATE [-1] ☐-NORMAL [0] ☐-NONE [1]

Substrate: 9 (Max 20)

2] INSTREAM COVER (see back for instructions for additional cover scoring method)
TYPE: (Check *All* That Apply)

- ☒ UNDERCUT BANKS [1]
- ☒ OVERHANGING VEGETATION [1]
- ☐ SHALLOWS (IN SLOW WATER) [1]
- NO ☒ ROOTMATS [1]
- ☐ POOLS> 70 cm [2]
- ☒ ROOTWADS [1]
- ☐ BOULDERS [1]
- ☐ OXBOWS, BACKWATERS [1]
- ☐ AQUATIC MACROPHYTES [1]
- ☐ LOGS OR WOODY DEBRIS [1]

COMMENTS: ______

AMOUNT: (Check *ONLY* One or check 2 and *AVERAGE*) ☒-EXTENSIVE > 75% [11] ☐-MODERATE 25-75% [7] ☐-SPARSE 5-25% [3] ☐-NEARLY ABSENT < 5%[1]

Cover: 14 (Max 20)

3] CHANNEL MORPHOLOGY: (Check *ONLY* One PER Category OR check 2 and *AVERAGE*)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY	MODIFICATIONS/OTHER	
☐-HIGH [4]	☐-EXCELLENT [7]	☐-NONE [6]	☐-HIGH [3]	☐-SNAGGING	☐-IMPOUND.
☒-MODERATE [3]	☒-GOOD [5]	☒-RECOVERED [4]	☒-MODERATE [2]	☐-RELOCATION	☐-ISLANDS
☐-LOW [2]	☐-FAIR [3]	☐-RECOVERING [3]	☐-LOW [1]	☐-CANOPY REMOVAL	☐-LEVEED
☐-NONE [1]	☐-POOR [1]	☐-RECENT OR NO RECOVERY [1]		☐-DREDGING	☐-BANK SHAPING
				☐-ONE SIDE CHANNEL MODIFICATIONS	

COMMENTS: ______

Channel: 14 (Max 20)

4]. RIPARIAN ZONE AND BANK EROSION-(check ONE box per bank or check 2 and AVERAGE per bank) ★River Right Looking Downstream★

RIPARIAN WIDTH L R (Per Bank):
- ☐☐-WIDE > 50m [4]
- ☒☒-MODERATE 10-50m [3]
- ☐☐-NARROW 5-10 m [2]
- ☐☐-VERY NARROW <5 m[1]
- ☐☐-NONE [0]

FLOOD PLAIN QUALITY (*PAST 100 Meter RIPARIAN*) L R (Most Predominant Per Bank):
- ☒☐-FOREST, SWAMP [3]
- ☐☒-SHRUB OR OLD FIELD [2]
- ☐☐-RESIDENTIAL,PARK,NEW FIELD [1]
- ☐☐-FENCED PASTURE [1]
- ☐☐-CONSERVATION TILLAGE [1]
- ☐☐-URBAN OR INDUSTRIAL [0]
- ☒☒-OPEN PASTURE, ROWCROP [0]
- ☐☐-MINING/CONSTRUCTION [0]

BANK EROSION L R (Per Bank):
- ☐☐-NONE/LITTLE [3]
- ☒☒-MODERATE [2]
- ☐☐-HEAVY/SEVERE[1]

COMMENTS: ______

Riparian: 7.5 (Max 10)

5.]POOL/GLIDE AND RIFFLE/RUN QUALITY

MAX. DEPTH (Check 1 ONLY!):
- ☐- >1m [6]
- ☐- 0.7-1m [4]
- ☒- 0.4-0.7m [2]
- ☐- 0.2-0.4m [1]
- ☐- < 0.2m [POOL=0]

MORPHOLOGY (Check 1 or 2 & AVERAGE):
- ☒-POOL WIDTH > RIFFLE WIDTH [2]
- ☐-POOL WIDTH = RIFFLE WIDTH [1]
- ☐-POOL WIDTH< RIFFLE W. [0]

CURRENT VELOCITY [POOLS & RIFFLES!] (Check *All* That Apply):
- ☐-EDDIES[1]
- ☒-FAST[1]
- ☐-MODERATE [1]
- ☒-SLOW [1]
- ☐-TORRENTIAL[-1]
- ☐-INTERSTITIAL[-1]
- ☐-INTERMITTENT[-2]

COMMENTS: ______

Pool/Current: 6 (Max 12)

CHECK ONE OR CHECK 2 AND AVERAGE

RIFFLE DEPTH:
- ☐-*Best Areas >10 cm [2]
- ☐-Best Areas 5-10 cm[1]
- ☒-Best Areas < 5 cm [RIFFLE=0]

RUN DEPTH:
- ☐-MAX > 50 [2]
- ☒-MAX < 50[1]

RIFFLE/RUN SUBSTRATE:
- ☐-STABLE (e.g.,Cobble, Boulder) [2]
- ☒-MOD. STABLE (e.g.,Large Gravel) [1]
- ☐-UNSTABLE (Fine Gravel,Sand) [0]

RIFFLE/RUN EMBEDDEDNESS:
- ☐-NONE [2]
- ☐-LOW [1]
- ☐-MODERATE [0]
- ☒-EXTENSIVE [-1]

COMMENTS: ______ ☐-NO RIFFLE [Metric=0]

Riffle/Run: 1 (Max 8)

6] GRADIENT (ft/mi): 5.62 DRAINAGE AREA (sq.mi.): 44.5
%POOL: 5 %GLIDE: ~~80~~ 75
%RIFFLE: 10 %RUN: 10

Gradient: 8 (Max 10)

*Best areas must be large enough to support a population of riffle-obligate fish species.

Is Sampling Reach Representative of the Stream (Y/N) ✓ If Not, Explain:

Major Suspected Sources of Impacts (Check All That Apply):
- None ☐
- Industrial ☑
- WWTP ☐
- Ag ☑
- Livestock ☐
- Silviculture ☐
- Construction ☐
- Urban Runoff ☑
- CSOs ☐
- Suburban Impacts ☐
- Mining ☐
- Channelization ☐
- Riparian Removal ☐
- Landfills ☐
- Natural ☐
- Dams ☐
- Other Flow Alteration ☐
- Other: ☐

Subjective Rating (1-10): 7

Aesthetic Rating (1-10): 9

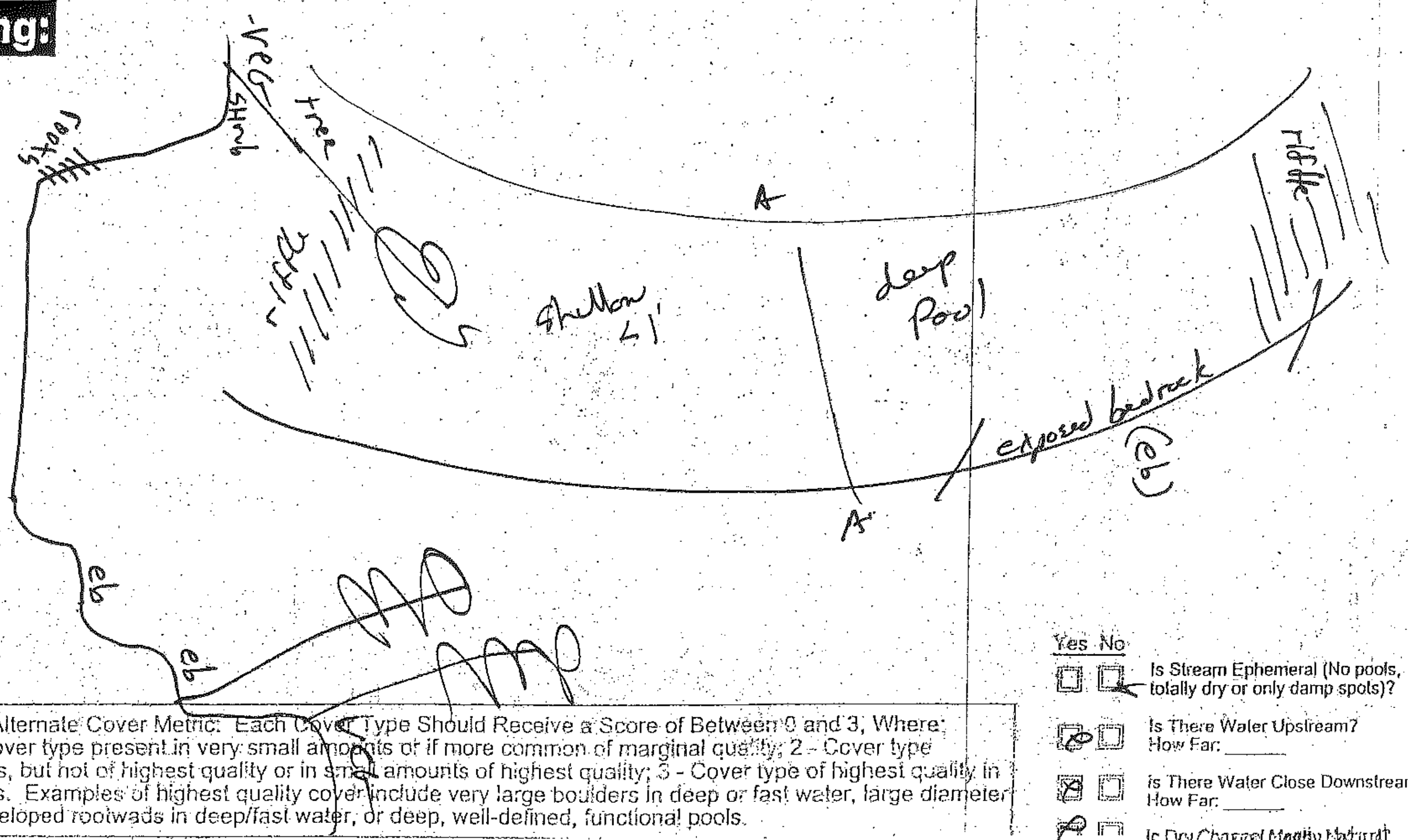
Gradient: ☐ - Low, ☐ - Moderate, ☐ -High

	Gear:	Distance:	Water Clarity:	Water Stage:	Canopy -% Open
First Sampling Pass					

Stream Measurements:

Average Width	Average Depth	Maximum Depth	Av. Bankfull Width	Bankfull Mean Depth	W/D Ratio	Bankfull Max Depth	Floodprone Area Width	Entrench. Ratio
40'	2'	4'	50	~~15'~~ 12'		20'		

Stream Drawing:



Instructions for Scoring the Alternate Cover Metric: Each Cover Type Should Receive a Score of Between 0 and 3, Where: 0 - Cover type absent; 1 - Cover type present in very small amounts or if more common of marginal quality; 2 - Cover type present in moderate amounts, but not of highest quality or in small amounts of highest quality; 3 - Cover type of highest quality in moderate or greater amounts. Examples of highest quality cover include very large boulders in deep or fast water, large diameter logs that are stable, well developed rootwads in deep/fast water, or deep, well-defined, functional pools.

Yes	No	
☐	☑	Is Stream Ephemeral (No pools, totally dry or only damp spots)?
☑	☐	Is There Water Upstream? How Far:
☑	☐	Is There Water Close Downstream? How Far:
☑	☐	Is Dry Channel Mostly Natural?

OhioEPA Qualitative Habitat Evaluation Index Field Sheet QHEI Score: 65

River Code: ______ RM: ______ Stream: Dicks Creek
Date: 8-17-04 Location: C
Scorers Initials: HMS (AM) Comments: ______

1] SUBSTRATE (Check *ONLY* Two Substrate *TYPE BOXES; Estimate % present*);

TYPE	POOL	RIFFLE	TYPE	POOL	RIFFLE
BLDR /SLBS [10]			GRAVEL [7]		50
BOULDER [9]			SAND [6]		
COBBLE [8]			BEDROCK [5]		
☒ HARDPAN [4]	50		DETRITUS [3]		
MUCK [2]			ARTIFICIAL [0]		
☒ SILT [2]	50				

NOTE: (Ignore sludge originating from point-sources; score on natural substrates)
NUMBER OF SUBSTRATE TYPES: ☐ 5 or More [2] ☒ 4 or Less [0]
COMMENTS: ______

SUBSTRATE ORIGIN — Check ONE (OR 2 & AVERAGE): ☐ LIMESTONE [1] ☒ TILLS [1] ☐ WETLANDS [0] ☒ HARDPAN [0] ☐ SANDSTONE [0] ☐ RIP/RAP [0] ☐ LACUSTRINE [0] ☐ SHALE [-1] ☐ COAL FINES [-2]

SUBSTRATE QUALITY — Check ONE (OR 2 & AVERAGE):
SILT: ☒ *SILT HEAVY [-2]* ☐ SILT MODERATE [-1] ☐ SILT NORMAL [0] ☐ SILT FREE [1]
EMBEDDEDNESS: ☐ EXTENSIVE [-2] ☐ MODERATE [-1] ☒ NORMAL [0] ☐ NONE [1]

Substrate: 6 (Max 20)

2] INSTREAM COVER (see back for instructions for additional cover scoring method)
TYPE: (Check *All* That Apply)
☒ UNDERCUT BANKS [1] ☐ POOLS> 70 cm [2] ☐ OXBOWS, BACKWATERS [1]
☒ OVERHANGING VEGETATION [1] ☒ ROOTWADS [1] ☐ AQUATIC MACROPHYTES [1]
☐ SHALLOWS (IN SLOW WATER) [1] ☐ BOULDERS [1] ☒ LOGS OR WOODY DEBRIS [1]
☒ ROOTMATS [1] COMMENTS: ______

AMOUNT: (Check *ONLY* One or check 2 and *AVERAGE*)
☒ EXTENSIVE > 75% [11] ☐ MODERATE 25-75% [7] ☐ SPARSE 5-25% [3] ☐ NEARLY ABSENT < 5% [1]

Cover: 16 (Max 20)

3] CHANNEL MORPHOLOGY: (Check *ONLY* One PER Category OR check 2 and *AVERAGE*)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY	MODIFICATIONS/OTHER	
☐ HIGH [4]	☒ EXCELLENT [7]	☒ NONE [6]	☒ HIGH [3]	☐ SNAGGING	☐ IMPOUND.
☒ MODERATE [3]	☐ GOOD [5]	☐ RECOVERED [4]	☐ MODERATE [2]	☐ RELOCATION	☐ ISLANDS
☐ LOW [2]	☐ FAIR [3]	☐ RECOVERING [3]	☐ LOW [1]	☐ CANOPY REMOVAL	☐ LEVEED
☐ NONE [1]	☐ POOR [1]	☐ RECENT OR NO RECOVERY [1]		☐ DREDGING	☐ BANK SHAPING
				☐ ONE SIDE CHANNEL MODIFICATIONS	

COMMENTS: ______

Channel: 19 (Max 20)

4] RIPARIAN ZONE AND BANK EROSION (check ONE box per bank or check 2 and AVERAGE per bank) ★River Right Looking Downstream★

RIPARIAN WIDTH — L R (Per Bank): ☐ ☒ WIDE > 50m [4] ☐ ☐ MODERATE 10-50m [3] ☒ ☐ NARROW 5-10 m [2] ☐ ☐ VERY NARROW < 5 m [1] ☐ ☐ NONE [0]

FLOOD PLAIN QUALITY (*PAST 100 Meter RIPARIAN*) — L R (Most Predominant Per Bank): ☐ ☒ FOREST, SWAMP [3] ☒ ☐ SHRUB OR OLD FIELD [2] ☐ ☒ RESIDENTIAL, PARK, NEW FIELD [1] ☐ ☐ FENCED PASTURE [1] ☐ ☐ CONSERVATION TILLAGE [1] ☐ ☐ URBAN OR INDUSTRIAL [0] ☐ ☐ OPEN PASTURE, ROWCROP [0] ☐ ☐ MINING/CONSTRUCTION [0]

BANK EROSION — L R (Per Bank): ☐ ☒ NONE/LITTLE [3] ☒ ☐ MODERATE [2] ☐ ☐ HEAVY/SEVERE [1]

COMMENTS: ______

Riparian: 7.5 (Max 10)

5] POOL/GLIDE AND RIFFLE/RUN QUALITY

MAX. DEPTH (Check 1 ONLY!): ☐ >1m [6] ☒ 0.7-1m [4] ☐ 0.4-0.7m [2] ☐ 0.2-0.4m [1] ☐ < 0.2m [POOL=0]

MORPHOLOGY (Check 1 or 2 & AVERAGE): ☒ POOL WIDTH > RIFFLE WIDTH [2] ☐ POOL WIDTH = RIFFLE WIDTH [1] ☐ POOL WIDTH < RIFFLE W. [0]

CURRENT VELOCITY [POOLS & RIFFLES!] (Check *All* That Apply): ☐ EDDIES [1] ☐ FAST [1] ☒ MODERATE [1] ☐ SLOW [1] ☐ TORRENTIAL [-1] ☐ INTERSTITIAL [-1] ☐ INTERMITTENT [-2]

COMMENTS: ______

Pool/Current: 7 (Max 12)

CHECK ONE OR CHECK 2 AND AVERAGE

RIFFLE DEPTH: ☐ Best Areas >10 cm [2] ☒ Best Areas 5-10 cm [1] ☐ Best Areas < 5 cm [RIFFLE=0]

RUN DEPTH: ☐ MAX > 50 [2] ☒ MAX < 50 [1]

RIFFLE/RUN SUBSTRATE: ☐ STABLE (e.g., Cobble, Boulder) [2] ☒ MOD. STABLE (e.g., Large Gravel) [1] ☐ UNSTABLE (Fine Gravel, Sand) [0]

RIFFLE/RUN EMBEDDEDNESS: ☐ NONE [2] ☐ LOW [1] ☒ MODERATE [0] ☐ EXTENSIVE [-1]

COMMENTS: ______ ☐ NO RIFFLE [Metric=0]

Riffle/Run: 3 (Max 8)

6] GRADIENT (ft/mi): 5.62 DRAINAGE AREA (sq.mi.): 44.5

%POOL: 5 %GLIDE: 65
%RIFFLE: 20 %RUN: 10

Gradient: 8 (Max 10)

*Best areas must be large enough to support a population of riffle-obligate fish species.

Is Sampling Reach Representative of the Stream (Y/N) ✓ If Not, Explain: ______

Major Suspected Sources of Impacts (Check All That Apply):

- None ☐
- Industrial ☒
- WWTP ☐
- Ag ☒
- Livestock ☐
- Silviculture ☐
- Construction ☐
- Urban Runoff ☒
- CSOs ☐
- Suburban Impacts ☐
- Mining ☐
- Channelization ☐
- Riparian Removal ☐
- Landfills ☐
- Natural ☐
- Dams ☐
- Other Flow Alteration ☐
- Other: ______ ☐

Subjective Rating (1-10): 6

Aesthetic Rating (1-10): 7

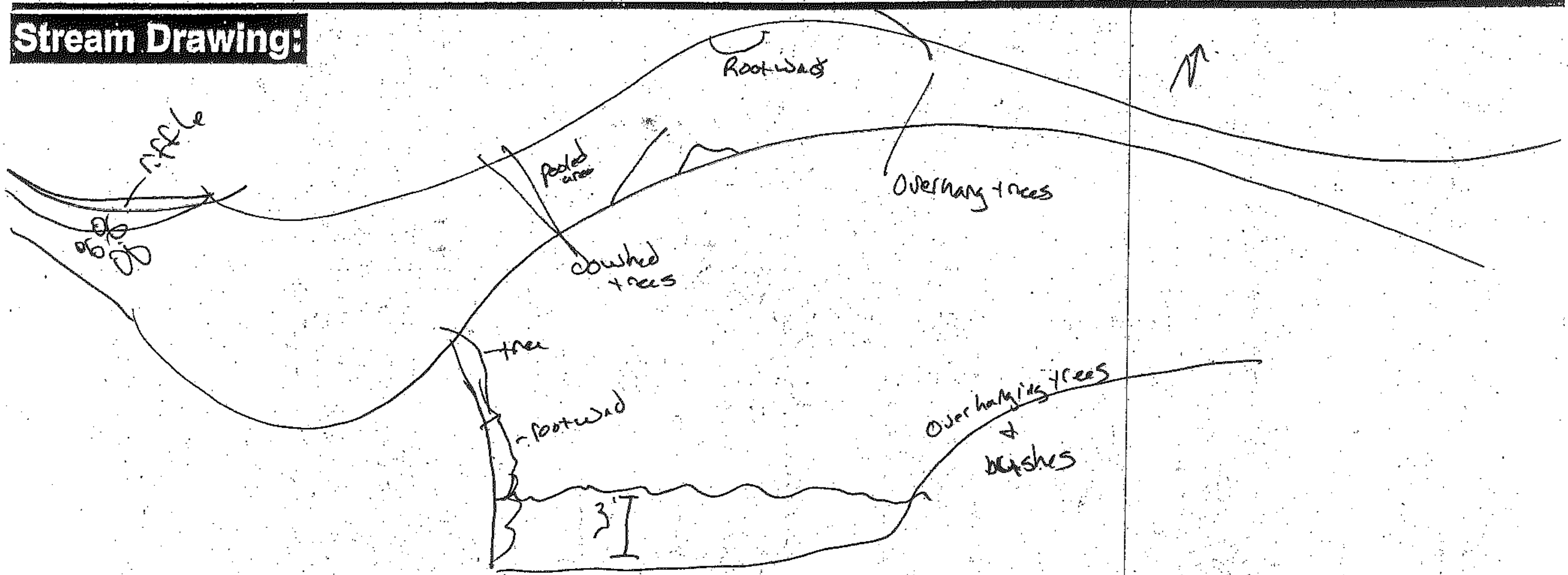
Gradient: ☐ - Low, ☐ - Moderate, ☐ -High

	Gear:	Distance:	Water Clarity:	Water Stage:	Canopy -% Open
First Sampling Pass					

Stream Measurements:

Average Width	Average Depth	Maximum Depth	Av. Bankfull Width	Bankfull Mean Depth	W/D Ratio	Bankfull Max Depth	Floodprone Area Width	Entrench. Ratio
50	3	6	~~12~~ 75	~~20~~ 12		20		

Stream Drawing:



Yes	No	
☐	☒	Is Stream Ephemeral (No pools, totally dry or only damp spots)?
☒	☐	Is There Water Upstream? How Far: ______
☒	☐	Is There Water Close Downstream? How Far: ______
☒	☐	Is Dry Channel Mostly Natural?

Instructions for Scoring the Alternate Cover Metric: Each Cover Type Should Receive a Score of Between 0 and 3, Where: 0 - Cover type absent; 1 - Cover type present in very small amounts or if more common of marginal quality; 2 - Cover type present in moderate amounts, but not of highest quality or in small amounts of highest quality; 3 - Cover type of highest quality in moderate or greater amounts. Examples of highest quality cover include very large boulders in deep or fast water, large diameter logs that are stable, well developed rootwads in deep/fast water, or deep, well-defined, functional pools.

OhioEPA Qualitative Habitat Evaluation Index Field Sheet QHEI Score: 65

River Code:________ RM: _____ Stream Dicks Creek
Date 8-19-01 Location D
Scorers Initials: AMS CAM Comments

1] SUBSTRATE (Check *ONLY* Two Substrate *TYPE BOXES; Estimate % present*);

TYPE POOL RIFFLE / POOL RIFFLE / SUBSTRATE ORIGIN / SUBSTRATE QUALITY

- ☐☐-BLDR /SLBS[10] ____ ____
- ☐☐-BOULDER [9] ____ ____
- ☒☐-COBBLE [8] ____ 80
- ☐☒-HARDPAN [4] 80 ____
- ☐☐-MUCK [2] ____ ____
- ☐☐-SILT [2] 20 ____
- ☐☐-GRAVEL [7] ____ 10
- ☐☐-SAND [6] ____ 10
- ☐☒-BEDROCK[5] ____ 10
- ☐☐-DETRITUS[3] ____ ____
- ☐☐-ARTIFICIAL[0] ____ ____

NOTE: (Ignore sludge originating from point-sources; score on natural substrates)

NUMBER OF SUBSTRATE TYPES: ☐-5 or More [2] ☒-4 or Less [0]

COMMENTS

Check ONE (OR 2 & AVERAGE)
- ☐ -LIMESTONE [1]
- ☐ -TILLS [1]
- ☐ -WETLANDS[0]
- ☒ -HARDPAN [0]
- ☐ -SANDSTONE [0]
- ☐ -RIP/RAP [0]
- ☐ -LACUSTRINE [0]
- ☐ -SHALE [-1]
- ☐ -COAL FINES [-2]

Check ONE (OR 2 & AVERAGE)

SILT:
- ☐ -SILT HEAVY [-2]
- ☒ -SILT MODERATE [-1]
- ☐ -SILT NORMAL [0]
- ☐ -SILT FREE [1]

EMBEDDEDNESS:
- ☐ -EXTENSIVE [-2]
- ☒ -MODERATE [-1]
- ☐ -NORMAL [0]
- ☐ -NONE [1]

Substrate: 10 (Max 20)

2] INSTREAM COVER (see back for instructions for additional cover scoring method)

TYPE: (Check *All* That Apply)
- ☒ ___UNDERCUT BANKS [1]
- ☒ ___OVERHANGING VEGETATION [1]
- ☐ ___SHALLOWS (IN SLOW WATER) [1]
- ☒ ___ROOTMATS [1]
- ☒ ___POOLS> 70 cm [2]
- ☒ ___ROOTWADS [1]
- ☐ ___BOULDERS [1]
- ☐ ___OXBOWS, BACKWATERS [1]
- ☐ ___AQUATIC MACROPHYTES [1]
- ☐ ___LOGS OR WOODY DEBRIS [1]

COMMENTS:

AMOUNT: (Check *ONLY* One or check 2 and *AVERAGE*)
- ☒ - EXTENSIVE > 75% [11]
- ☐ - MODERATE 25-75% [7]
- ☐ - SPARSE 5-25% [3]
- ☐ - NEARLY ABSENT < 5%[1]

Cover: 16 (Max 20)

3] CHANNEL MORPHOLOGY: (Check *ONLY* One PER Category OR check 2 and *AVERAGE*)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY	MODIFICATIONS/OTHER	
☐ - HIGH [4]	☒ - EXCELLENT [7]	☒ - NONE [6]	☒ - HIGH [3]	☐ - SNAGGING	☐ - IMPOUND.
☒ - MODERATE [3]	☐ - GOOD [5]	☐ - RECOVERED [4]	☐ - MODERATE [2]	☐ - RELOCATION	☐ - ISLANDS
☐ - LOW [2]	☐ - FAIR [3]	☐ - RECOVERING [3]	☐ - LOW [1]	☐ - CANOPY REMOVAL	☐ - LEVEED
☐ - NONE [1]	☐ - POOR [1]	☐ - RECENT OR NO RECOVERY [1]		☐ - DREDGING	☐ - BANK SHAPING
				☐ - ONE SIDE CHANNEL MODIFICATIONS	

COMMENTS:

Channel: 19 (Max 20)

4]. RIPARIAN ZONE AND BANK EROSION-(check ONE box per bank or check 2 and AVERAGE per bank) ★River Right Looking Downstream★

RIPARIAN WIDTH — L R (Per Bank)
- ☒☐ -WIDE > 50m [4]
- ☐☒ - MODERATE 10-50m [3]
- ☐☐ -NARROW 5-10 m [2]
- ☐☐ - VERY NARROW <5 m[1]
- ☐☐ - NONE [0]

FLOOD PLAIN QUALITY (*PAST 100 Meter RIPARIAN*) — L R (Most Predominant Per Bank)
- ☐ ☐-FOREST, SWAMP [3]
- ☒ ☒-SHRUB OR OLD FIELD [2]
- ☐ ☒-RESIDENTIAL, PARK, NEW FIELD [1]
- ☐ ☐ -FENCED PASTURE [1]
- ☐ ☐-CONSERVATION TILLAGE [1]
- ☐ ☐-URBAN OR INDUSTRIAL [0]
- ☐ ☐-OPEN PASTURE, ROWCROP [0]
- ☐ ☐-MINING/CONSTRUCTION [0]

BANK EROSION — L R (Per Bank)
- ☒ ☐ -NONE/LITTLE [3]
- ☐ ☒ -MODERATE [2]
- ☐ ☐ -HEAVY/SEVERE[1]

COMMENTS:

Riparian: 7.5 (Max 10)

5.]POOL/GLIDE AND RIFFLE/RUN QUALITY

MAX. DEPTH (Check 1 ONLY!)
- ☐ - >1m [6]
- ☒ - 0.7-1m [4]
- ☐ - 0.4-0.7m [2]
- ☐ - 0.2-0.4m [1]
- ☐ - < 0.2m [POOL=0]

MORPHOLOGY (Check 1 or 2 & AVERAGE)
- ☐ -POOL WIDTH > RIFFLE WIDTH [2]
- ☒ -POOL WIDTH = RIFFLE WIDTH [1]
- ☐ -POOL WIDTH < RIFFLE W. [0]

CURRENT VELOCITY [POOLS & RIFFLES!] (Check *All* That Apply)
- ☐ -EDDIES[1]
- ☒ -FAST[1]
- ☐ -MODERATE [1]
- ☐ -SLOW [1]
- ☐ -TORRENTIAL[-1]
- ☐ -INTERSTITIAL[-1]
- ☐ -INTERMITTENT[-2]

COMMENTS:

Pool/Current: 6 (Max 12)

CHECK ONE OR CHECK 2 AND AVERAGE

RIFFLE DEPTH
- ☐ - *Best Areas >10 cm [2]
- ☒ - Best Areas 5-10 cm[1]
- ☐ - Best Areas < 5 cm [RIFFLE=0]

RUN DEPTH
- ☐ - MAX > 50 [2]
- ☒ - MAX < 50[1]

RIFFLE/RUN SUBSTRATE
- ☐-STABLE (e.g.,Cobble, Boulder) [2]
- ☒-MOD. STABLE (e.g.,Large Gravel) [1]
- ☐-UNSTABLE (Fine Gravel, Sand) [0]

RIFFLE/RUN EMBEDDEDNESS
- ☐ - NONE [2]
- ☐ - LOW [1]
- ☒ - MODERATE [0]
- ☐ - EXTENSIVE [-1]

COMMENTS: ☐ - NO RIFFLE [Metric=0]

Riffle/Run: 3 (Max 8)

6] GRADIENT (ft/mi): 5.62 DRAINAGE AREA (sq.mi.): 45

%POOL: 50 %GLIDE: 10
%RIFFLE: 30 %RUN: 10

Gradient: 8 (Max 10)

*Best areas must be large enough to support a population of riffle-obligate fish species.

Is Sampling Reach Representative of the Stream (Y/N) Y If Not, Explain: ______________________

Major Suspected Sources of Impacts (Check All That Apply):

- None ☐
- Industrial ☑
- WWTP ☐
- Ag ☐
- Livestock ☐
- Silviculture ☐
- Construction ☐
- Urban Runoff ☑
- CSOs ☐
- Suburban Impacts ☐
- Mining ☐
- Channelization ☐
- Riparian Removal ☐
- Landfills ☐
- Natural ☐
- Dams ☐
- Other Flow Alteration ☐
- Other: ______ ☐

Some empty drums + debris in river

Subjective Rating (1-10): 6

Aesthetic Rating (1-10): 6

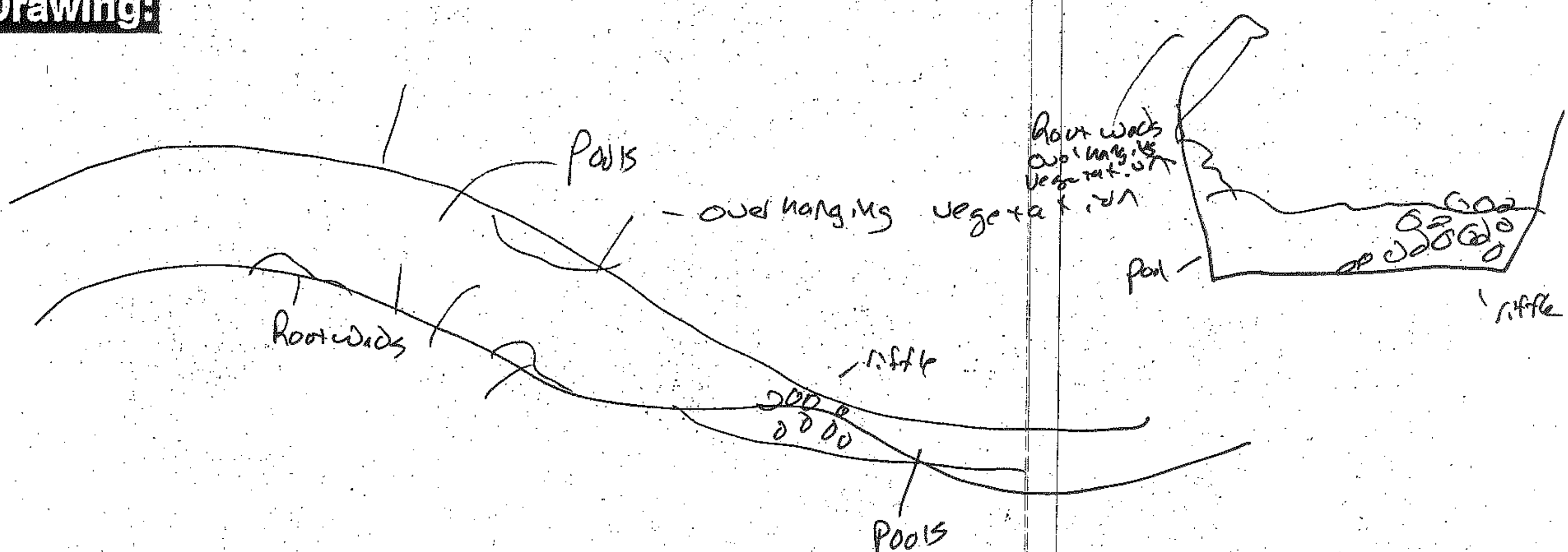
Gradient: ☐ - Low, ☐ - Moderate, ☐ -High

	Gear:	Distance:	Water Clarity:	Water Stage:	Canopy -% Open
First Sampling Pass					

Stream Measurements:

Average Width	Average Depth	Maximum Depth	Av. Bankfull Width	Bankfull Mean Depth	W/D Ratio	Bankfull Max Depth	Floodprone Area Width	Entrench Ratio
45'	2.5'	3'	60'	5'		8'		

Stream Drawing:



Yes	No	
☐	☒	Is Stream Ephemeral (No pools, totally dry or only damp spots)?
☒	☐	Is There Water Upstream? How Far: ______
☒	☐	Is There Water Close Downstream? How Far: ______
☒	☐	Is Dry Channel Mostly Natural

Instructions for Scoring the Alternate Cover Metric: Each Cover Type Should Receive a Score of Between 0 and 3, Where: 0 - Cover type absent; 1 - Cover type present in very small amounts or if more common of marginal quality; 2 - Cover type present in moderate amounts, but not of highest quality or in small amounts of highest quality; 3 - Cover type of highest quality in moderate or greater amounts. Examples of highest quality cover include very large boulders in deep or fast water, large diameter logs that are stable, well developed rootwads in deep/fast water, or deep, well-defined, functional pools.

OhioEPA Qualitative Habitat Evaluation Index Field Sheet QHEI Score: 47

River Code:____ RM: ____ Stream Dick's Creek
Date 8-19-04 Location E
Scorers Initials: WS/AM Comments

1] SUBSTRATE (Check *ONLY* Two Substrate *TYPE BOXES*; *Estimate % present*);

TYPE POOL RIFFLE / POOL RIFFLE

☐☐-BLDR /SLBS[10]
☐☐-BOULDER [9]
☒☒-COBBLE [8] some
☐☒-HARDPAN [4] 80
☐☐-MUCK [2]
☐☒-SILT [2] 20
☒☒-GRAVEL [7] 50 some
☐☐-SAND [6] 20 some
☐☐-BEDROCK[5]
☐☐-DETRITUS[3]
☐☐-ARTIFICIAL[0]

NOTE: (Ignore sludge originating from point-sources; score on natural substrates)

NUMBER OF SUBSTRATE TYPES: ☒-5 or More [2] ☐-4 or Less [0]

COMMENTS

SUBSTRATE ORIGIN Check ONE (OR 2 & AVERAGE)
☐ -LIMESTONE [1]
☐ -TILLS [1]
☐ -WETLANDS[0]
☒ -HARDPAN [0]
☐ -SANDSTONE [0]
☐ -RIP/RAP [0]
☐ -LACUSTRINE [0]
☐ -SHALE [-1]
☐ -COAL FINES [-2]

SUBSTRATE QUALITY Check ONE (OR 2 & AVERAGE)
SILT: ☐ -SILT HEAVY [-2] ☒ -SILT MODERATE [-1] ☐ -SILT NORMAL [0] ☐ -SILT FREE [1]
EMBEDDEDNESS: ☒ -EXTENSIVE [-2] ☐ -MODERATE [-1] ☐ -NORMAL [0] ☐ -NONE [1]

Substrate 3 Max 20

2] INSTREAM COVER (see back for instructions for additional cover scoring method)

TYPE: (Check *All* That Apply)

☐ __UNDERCUT BANKS [1]
☒ __OVERHANGING VEGETATION [1]
☐ __SHALLOWS (IN SLOW WATER) [1]
☐ __ROOTMATS [1]
☐ __POOLS> 70 cm [2]
☒ __ROOTWADS [1]
☐ __BOULDERS [1]
☐ __OXBOWS, BACKWATERS [1]
☐ __AQUATIC MACROPHYTES [1]
☒ __LOGS OR WOODY DEBRIS [1]

COMMENTS:

AMOUNT: (Check *ONLY* One or check 2 and *AVERAGE*)
☐ - EXTENSIVE > 75% [11]
☒ - MODERATE 25-75% [7]
☒ - SPARSE 5-25% [3]
☐ - NEARLY ABSENT < 5%[1]

Cover 10 Max 20

3] CHANNEL MORPHOLOGY: (Check *ONLY* One PER Category OR check 2 and *AVERAGE*)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY	MODIFICATIONS/OTHER	
☐ - HIGH [4]	☐ - EXCELLENT [7]	☐ - NONE [6]	☒ - HIGH [3]	☐ - SNAGGING	☐ - IMPOUND.
☒ - MODERATE [3]	☒ - GOOD [5]	☒ - RECOVERED [4]	☐ - MODERATE [2]	☐ - RELOCATION	☐ - ISLANDS
☐ - LOW [2]	☐ - FAIR [3]	☐ - RECOVERING [3]	☐ - LOW [1]	☒ - CANOPY REMOVAL	☐ - LEVEED
☐ - NONE [1]	☐ - POOR [1]	☐ - RECENT OR NO RECOVERY [1]		☐ - DREDGING	☐ - BANK SHAPING
				☐ - ONE SIDE CHANNEL MODIFICATIONS	

Channel 15 Max 20

COMMENTS:

4]. RIPARIAN ZONE AND BANK EROSION-(check ONE box per bank or check 2 and AVERAGE per bank) ★River Right Looking Downstream★

RIPARIAN WIDTH L R (Per Bank)
☒☐ - WIDE > 50m [4]
☐☐ - MODERATE 10-50m [3]
☐☒ - NARROW 5-10 m [2]
☐☒ - VERY NARROW <5 m[1]
☐☐ - NONE [0]

FLOOD PLAIN QUALITY (*PAST 100 Meter RIPARIAN*) L R (Most Predominant Per Bank)
☒☐ -FOREST, SWAMP [3]
☐☐ -SHRUB OR OLD FIELD [2]
☐☒ -RESIDENTIAL, PARK, NEW FIELD [1]
☐☐ -FENCED PASTURE [1]
☐☐ -CONSERVATION TILLAGE [1]
☐☐ -URBAN OR INDUSTRIAL [0]
☐☐ -OPEN PASTURE, ROWCROP [0]
☐☐ -MINING/CONSTRUCTION [0]

BANK EROSION L R (Per Bank)
☒☐ -NONE/LITTLE [3]
☐☒ -MODERATE [2]
☐☐ -HEAVY/SEVERE[1]

Riparian 7 Max 10

COMMENTS:

5.]POOL/GLIDE AND RIFFLE/RUN QUALITY

MAX. DEPTH (Check 1 ONLY!)
☐ - >1m [6]
☐ - 0.7-1m [4]
☒ - 0.4-0.7m [2]
☐ - 0.2- 0.4m [1]
☐ - < 0.2m [POOL=0]

MORPHOLOGY (Check 1 or 2 & AVERAGE)
☐ -POOL WIDTH > RIFFLE WIDTH [2]
☒ -POOL WIDTH = RIFFLE WIDTH [1]
☐ -POOL WIDTH< RIFFLE W. [0]

CURRENT VELOCITY [POOLS & RIFFLES!] (Check *All* That Apply)
☐ -EDDIES[1] ☐ -TORRENTIAL[-1]
☐ -FAST[1] ☐ -INTERSTITIAL[-1]
☒ -MODERATE [1] ☐ -INTERMITTENT[-2]
☐ -SLOW [1]

COMMENTS:

Pool/Current 4 Max 12

CHECK ONE OR CHECK 2 AND AVERAGE

RIFFLE DEPTH
☐ - Best Areas >10 cm [2]
☐ - Best Areas 5-10 cm[1]
☐ - Best Areas < 5 cm [RIFFLE=0]

RUN DEPTH
☐ - MAX > 50 [2]
☐ - MAX < 50[1]

RIFFLE/RUN SUBSTRATE
☐ -STABLE (e.g., Cobble, Boulder) [2]
☐ -MOD. STABLE (e.g., Large Gravel) [1]
☐ -UNSTABLE (Fine Gravel, Sand) [0]

RIFFLE/RUN EMBEDDEDNESS
☐ - NONE [2]
☐ - LOW [1]
☐ - MODERATE [0]
☐ - EXTENSIVE [-1]

COMMENTS: ☒ - NO RIFFLE [Metric=0]

Riffle/Run 0 Max 8

Gradient 8 Max 10

6] GRADIENT (ft/mi): 9.09 WS 5.62 DRAINAGE AREA (sq.mi.): 46 45

%POOL: 100 AMS %GLIDE: 100
%RIFFLE: %RUN:

*Best areas must be large enough to support a population of riffle-obligate fish species.

Is Sampling Reach Representative of the Stream (Y/N) ✓ If Not, Explain:

~~channelized~~ RMS w/ steep water/flow is a glide because of dams/ bridges in area backing up water flow

Subjective Rating (1-10)	Aesthetic Rating (1-10)
6	6

Gradient: ☐ - Low, ☐ - Moderate, ☐ -High

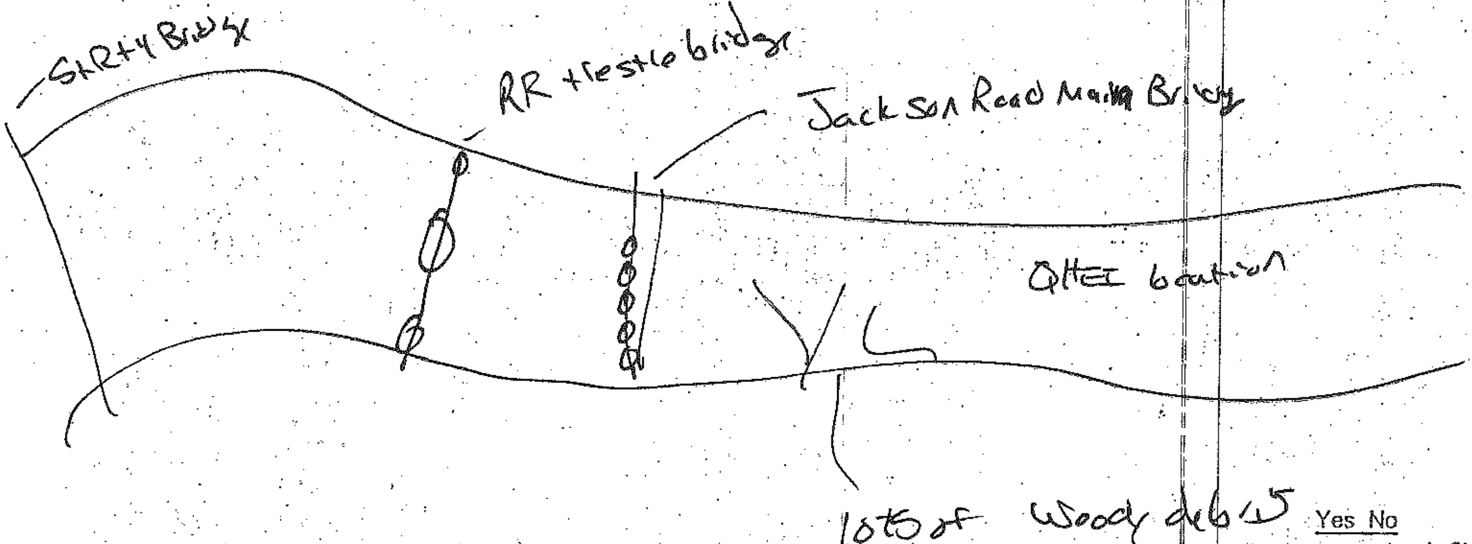
	Gear:	Distance:	Water Clarity:	Water Stage:	Canopy -% Open
First Sampling Pass					

Stream Measurements:

Average Width	Average Depth	Maximum Depth	Av. Bankfull Width	Bankfull Mean Depth	W/D Ratio	Bankfull Max Depth	Floodprone Area Width	Entrench Ratio
40'	2'	2.5	75	3'		10'		

Major Suspected Sources of Impacts (Check All That Apply):
- None ☐
- Industrial ☐
- WWTP ☐
- Ag ☒
- Livestock ☐
- Silviculture ☐
- Construction ☐
- Urban Runoff ☐
- CSOs ☐
- Suburban Impacts ☐
- Mining ☐
- Channelization ☐
- Riparian Removal ☒
- Landfills ☐
- Natural ☐
- Dams ☒
- Other Flow Alteration ☐
- Other: ______ ☐

Stream Drawing:



Yes	No	
☐	☒	Is Stream Ephemeral (No pools, totally dry or only damp spots)?
☒	☐	Is There Water Upstream? How Far: ______
☒	☐	Is There Water Close Downstream? How Far: ______
?	☐	Is Dry Channel Mostly Natural?

Instructions for Scoring the Alternate Cover Metric: Each Cover Type Should Receive a Score of Between 0 and 3, Where: 0 - Cover type absent; 1 - Cover type present in very small amounts or if more common of marginal quality; 2 - Cover type present in moderate amounts, but not of highest quality or in small amounts of highest quality; 3 - Cover type of highest quality in moderate or greater amounts. Examples of highest quality cover include very large boulders in deep or fast water, large diameter logs that are stable, well developed rootwads in deep/fast water, or deep, well-defined, functional pools.

Ohio EPA Qualitative Habitat Evaluation Index Field Sheet QHEI Score: 45

River Code: ______ RM: ______ Stream Nick's Creek
Date 9-6-01 Location F
Scorers Initials: JLMS CAM Comments ______

1] SUBSTRATE (Check *ONLY* Two Substrate *TYPE BOXES; Estimate % present*);

TYPE — POOL RIFFLE
- ☐☐-BLDR /SLBS[10]
- ☐☒-BOULDER [9]
- ☒☐-COBBLE [8]
- ☐☐-HARDPAN [4]
- ☐☐-MUCK [2]
- ☐☐-SILT [2]
- ☐☐-GRAVEL [7]
- ☐☐-SAND [6]
- ☐☐-BEDROCK[5]
- ☐☐-DETRITUS[3]
- ☐☐-ARTIFICIAL[0]

NOTE: (Ignore sludge originating from point-sources; score on natural substrates)
NUMBER OF SUBSTRATE TYPES: ☐-5 or More [2] ☒-4 or Less [0]
COMMENTS ______

SUBSTRATE ORIGIN — Check ONE (OR 2 & AVERAGE)
- ☐ -LIMESTONE [1]
- ☐ -TILLS [1]
- ☐ -WETLANDS[0]
- ☒ -HARDPAN [0]
- ☐ -SANDSTONE [0]
- ☒ -RIP/RAP [0]
- ☐ -LACUSTRINE [0]
- ☐ -SHALE [-1]
- ☐ -COAL FINES [-2]

SUBSTRATE QUALITY — Check ONE (OR 2 & AVERAGE)
SILT:
- ☐ -*SILT HEAVY [-2]*
- ☒ -SILT MODERATE [-1]
- ☐ -SILT NORMAL [0]
- ☐ -SILT FREE [1]

EMBEDDEDNESS:
- ☒ -EXTENSIVE [-2]
- ☐ -MODERATE [-1]
- ☐ -NORMAL [0]
- ☐ -NONE [1]

Substrate: 14 (Max 20)

2] INSTREAM COVER (see back for instructions for additional cover scoring method)

TYPE: (Check *All* That Apply)
- ☐ ___UNDERCUT BANKS [1]
- ☒ ___OVERHANGING VEGETATION [1]
- ☐ ___SHALLOWS (IN SLOW WATER) [1]
- ☐ ___ROOTMATS [1]
- ☐ ___POOLS> 70 cm [2]
- ☐ ___ROOTWADS [1]
- ☐ ___BOULDERS [1]
- ☐ ___OXBOWS, BACKWATERS [1]
- ☒ ___AQUATIC MACROPHYTES [1]
- ☐ ___LOGS OR WOODY DEBRIS [1]

COMMENTS: ______

AMOUNT: (Check *ONLY* One or check 2 and *AVERAGE*)
- ☐ - EXTENSIVE > 75% [11]
- ☐ - MODERATE 25-75% [7]
- ☐ - SPARSE 5-25% [3]
- ☒ - NEARLY ABSENT < 5%[1]

Cover: 3 (Max 20)

3] CHANNEL MORPHOLOGY: (Check *ONLY* One PER Category OR check 2 and *AVERAGE*)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY	MODIFICATIONS/OTHER	
☐ - HIGH [4]	☐ - EXCELLENT [7]	☐ - NONE [6]	☐ - HIGH [3]	☐ - SNAGGING	☐ - IMPOUND.
☐ - MODERATE [3]	☐ - GOOD [5]	☐ - RECOVERED [4]	☒ - MODERATE [2]	☐ - RELOCATION	☐ - ISLANDS
☐ - LOW [2]	☐ - FAIR [3]	☐ - RECOVERING [3]	☐ - LOW [1]	☐ - CANOPY REMOVAL	☒ - LEVEED
☒ - NONE [1]	☒ - POOR [1]	☒ - RECENT OR NO RECOVERY [1]		☒ - DREDGING	☒ - BANK SHAPING
				☐ - ONE SIDE CHANNEL MODIFICATIONS	

COMMENTS: ______

Channel: 5 (Max 20)

4]. RIPARIAN ZONE AND BANK EROSION-(check ONE box per bank or check 2 and AVERAGE per bank) ★River Right Looking Downstream★

RIPARIAN WIDTH — L R (Per Bank)
- ☐☐ - WIDE > 50m [4]
- ☐☐ - MODERATE 10-50m [3]
- ☐☐ - NARROW 5-10 m [2]
- ☐☐ - VERY NARROW <5 m[1]
- ☒☒ - NONE [0]

FLOOD PLAIN QUALITY (*PAST 100 Meter RIPARIAN*) — L R (Most Predominant Per Bank)
- ☐☐-FOREST, SWAMP [3]
- ☒☒-SHRUB OR OLD FIELD [2]
- ☐☐-RESIDENTIAL,PARK,NEW FIELD [1]
- ☐☐-FENCED PASTURE [1]
- ☐☐-CONSERVATION TILLAGE [1]
- ☐☐-URBAN OR INDUSTRIAL [0]
- ☐☐-OPEN PASTURE,ROWCROP [0]
- ☐☐-MINING/CONSTRUCTION [0]

BANK EROSION — L R (Per Bank)
- ☒☒ -NONE/LITTLE [3]
- ☐☐ -MODERATE [2]
- ☐☐ -HEAVY/SEVERE[1]

COMMENTS: ______

Riparian: 5 (Max 10)

5.]POOL/GLIDE AND RIFFLE/RUN QUALITY

MAX. DEPTH (Check 1 ONLY!)
- ☐ - >1m [6]
- ☐ - 0.7-1m [4]
- ☒ - 0.4-0.7m [2]
- ☐ - 0.2-0.4m [1]
- ☐ - < 0.2m [POOL=0]

MORPHOLOGY (Check 1 or 2 & AVERAGE)
- ☒ -POOL WIDTH > RIFFLE WIDTH [2]
- ☐ -POOL WIDTH = RIFFLE WIDTH [1]
- ☐ -POOL WIDTH< RIFFLE W. [0]

CURRENT VELOCITY [POOLS & RIFFLES!] (Check *All* That Apply)
- ☐ -EDDIES[1]
- ☐ -FAST[1]
- ☒ -MODERATE [1]
- ☐ -SLOW [1]
- ☐ -TORRENTIAL[-1]
- ☐ -INTERSTITIAL[-1]
- ☐ -INTERMITTENT[-2]

COMMENTS: ______

Pool/Current: 5 (Max 12)

CHECK ONE OR CHECK 2 AND AVERAGE

RIFFLE DEPTH
- ☐ - *Best Areas >10 cm [2]
- ☐ - Best Areas 5-10 cm[1]
- ☒ - Best Areas < 5 cm [RIFFLE=0]

RUN DEPTH
- ☒ - MAX > 50 [2]
- ☐ - MAX < 50[1]

RIFFLE/RUN SUBSTRATE
- ☐-STABLE (e.g.,Cobble, Boulder) [2]
- ☒-MOD. STABLE (e.g.,Large Gravel) [1]
- ☐-UNSTABLE (Fine Gravel,Sand) [0]

RIFFLE/RUN EMBEDDEDNESS
- ☐ - NONE [2]
- ☐ - LOW [1]
- ☒ - MODERATE [0]
- ☐ - EXTENSIVE [-1]

COMMENTS: ______ ☐ - NO RIFFLE [Metric=0]

Riffle/Run: 3 (Max 8)

6] GRADIENT (ft/mi): 9.09 DRAINAGE AREA (sq.mi.): 46

%POOL: 60 %GLIDE: 15
%RIFFLE: 20 %RUN: 5

Gradient: 10 (Max 10)

*Best areas must be large enough to support a population of riffle-obligate fish species.

Is Sampling Reach Representative of the Stream (Y/N)___ If Not, Explain: this strech is channelized w/ steep
banks on either side

Major Suspected Sources of Impacts (Check All That Apply):
None ☐
Industrial ☐
WWTP ☐
Ag ☐
Livestock ☐
Silviculture ☐
Construction ☐
Urban Runoff ☒
CSOs ☐
Suburban Impacts ☐
Mining ☐
Channelization ☒
Riparian Removal ☒
Landfills ☐
Natural ☐
Dams ☐
Other Flow Alteration ☐
Other:__________ ☐

Subjective Rating (1-10)	Aesthetic Rating (1-10)
4	4

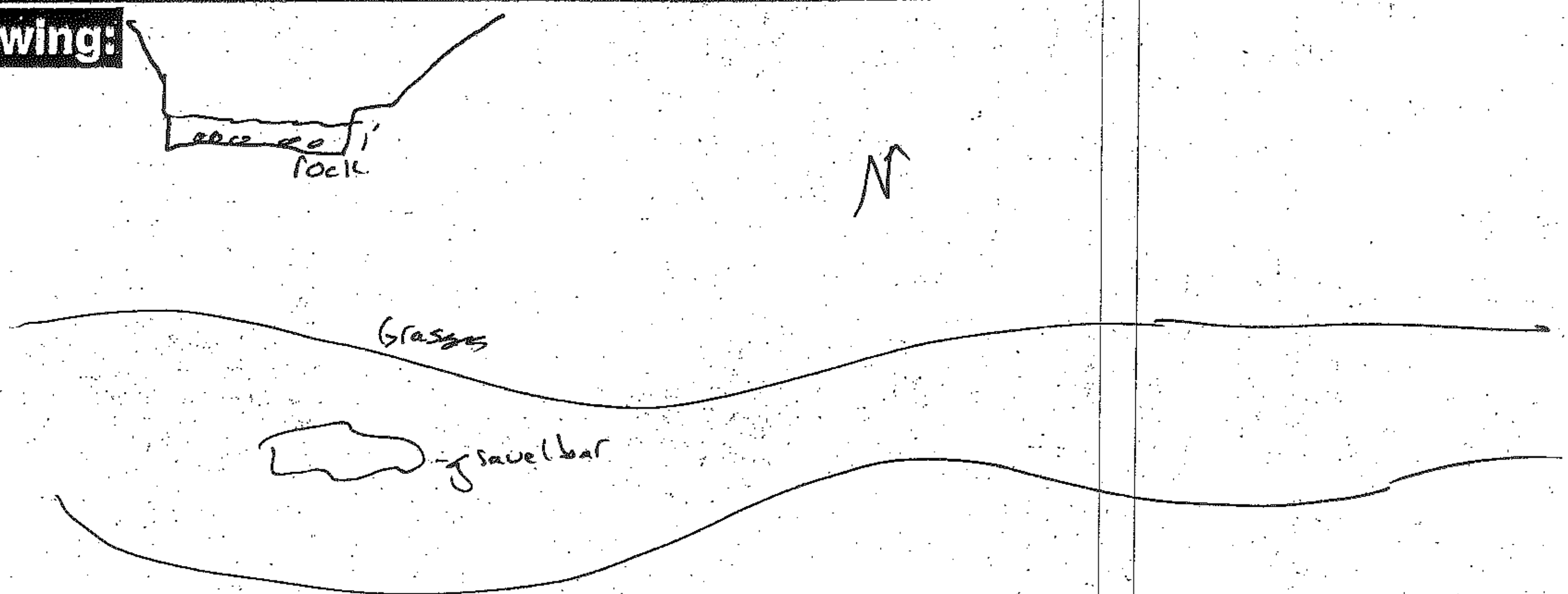
Gradient: ☐ - Low, ☐ - Moderate, ☐ -High

	Gear:	Distance:	Water Clarity:	Water Stage:	Canopy -% Open
First Sampling Pass					

Stream Measurements:

Average Width	Average Depth	Maximum Depth	Av. Bankfull Width	Bankfull Mean Depth	W/D Ratio	Bankfull Max Depth	Floodprone Area Width	Entrench Ratio
25	1'	18"	100	~~20'~~ 15'		20		

Stream Drawing:



Instructions for Scoring the Alternate Cover Metric: Each Cover Type Should Receive a Score of Between 0 and 3, Where: 0 - Cover type absent; 1 - Cover type present in very small amounts or if more common of marginal quality; 2 - Cover type present in moderate amounts, but not of highest quality or in small amounts of highest quality; 3 - Cover type of highest quality in moderate or greater amounts. Examples of highest quality cover include very large boulders in deep or fast water, large diameter logs that are stable, well developed rootwads in deep/fast water, or deep, well-defined, functional pools.

Yes	No	
☐	☒	Is Stream Ephemeral (No pools, totally dry or only damp spots)?
☒	☐	Is There Water Upstream? How Far: _______
☒	☐	Is There Water Close Downstream? How Far: _______
☐	☐	Is Dry Channel Mostly Natural?

United States Environmental Protection Agency

INVESTIGATIVE ACTIVITY REPORT

Case Name:
AK STEEL

Reporting Office:
CHICAGO

Subject of Report:
VISIT TO VICINITY OF DICK'S CREEK IN MIDDLETOWN, OHIO, WITH KURT A. RINEHART, CIVIL ENGINEER, MIAMI CONSERVANCY DISTRICT
Date of Meeting: November 12, 2004

Copies to:
Robert Guenther, Associate Regional Counsel, Region 5
Robert Darnell, Trial Attorney, Environmental and Natural Resources Division, U.S. Department of Justice

Related Files:

Reporting Official and Date:

11/16/04
Reginald Arkell, CI

Approving Official and Date:

INTRODUCTION

Pursuant to a request by the U.S. EPA, Office of Regional Counsel, Region 5, and the Environmental and Natural Resources Division of the U.S. Department of Justice, CI Reginald Arkell previously researched records of the Miami Conservancy District (MCD) in Dayton, Ohio, pertaining to Dick's Creek. Copies of records were obtained concerning excavation and dredging work performed at the creek in the vicinity of the AK Steel facility in Middletown, Ohio, during the mid-1960s through the mid-1980s. The research is documented in memorandums dated February 4, 2004, and July 1, 2004. The purpose of the research was to help identify the movement of potential PCB-laden material alleged to have originated from AK Steel so that any contamination can be remediated.

Reference is made to a previous interview of Kurt Rinehart, Civil Engineer, MCD, documented in the July 1, 2004, memorandum. On November 12, 2004, CI Arkell again met with Mr. Rinehart to discuss his recollection of where material removed from the vicinity of Dick's Creek in 1984 may have been placed. Copies of ten MCD *Daily Construction Reports*, dated from July 25, 1984, through September 13, 1984, documenting work performed at Dick's Creek were provided for Mr. Rinehart's review. A 22"x32" map depicting Dick's Creek from Sta. 0+00 to Sta. 160+00, dated

February 10, 1966, that had been copied from MCD records was also provided for viewing. CI Arkell and Mr. Rinehart made a site visit to this vicinity. The information below was obtained.

DETAILS

- The Dick's Creek project work in 1984 focused on excavating material from the banks of the waterway to relieve a low flow condition as opposed to dredging or removing material from the creek bed. Some low spots adjacent to the creek may have been filled in but the majority of the material removed was deposited in areas farther away from the creek. A backhoe may have been used to shape the channel, however, he believes some type of equipment with a scraper was used to remove most of the material.

- In 1984, he visited the general area of Dick's Creek between about Yankee Road on the west and Breiel Road on the east an average of about once a week while excavation activities were taking place. He identified Dick Kelchner Excavating, Inc., as the contractor that performed the work. He believes that Dick Kelchner himself is retired and may be deceased. He said Todd Kelchner was also involved in the excavation activities at Dick's Creek in 1984 and is now the president of the company.

- Mr. Rinehart pointed out, both on a map and during the visit to Middletown, areas where excavated material from Dick's Creek was placed. See *Figure 2* for a map showing the location of these areas. One location is on the [redacted]
  - An Internet Web query in www.smartpages.com found that [redacted]
  - A query in the Butler County Auditor Internet Web Site found that [redacted] is the owner/taxpayer of four parcels of property listed below.
    - [redacted]

[redacted]

- The general area of the [redacted] property is highlighted in green and labeled on *Figure 2*. Based on a review of data and a GIS map on the Butler County Auditor Internet Web Site, it is unclear where the exact boundaries are for each of the four parcels.

- Mr. Rinehart identified another area where material from Dick's Creek was moved. This area is adjacent to and on the south side of Dick's Creek located southwest from the [redacted] properties between the same railroad tracks and Yankee Road (Orman Welding Center property).
  - An Internet Web query in www.smartpages.com found that Orman's Welding Center has a listing of (513) 422-1999 at 3344 Yankee Road, Middletown, OH 45044.
  - A query in the Butler County Auditor Internet Web Site found that Orman Family, LLC, is the owner/taxpayer of property located at 3344 Yankee Road, PIN: Q6542061000014, 4.935 acres.
  - The general area of the Orman Welding property is highlighted in pink on *Figure 2*.

- Reference is made to the interview report of [redacted] dated November 15, 2004, documenting corroboration of movement of fill to both the aforementioned [redacted] and welding company locations. Photographs of these properties can also be found in that report. [redacted] had identified another parcel of land located where he said material from Dick's Creek was deposited. This location had been the site for the Glenn Cartage Company at one time. The property is adjacent to Yankee Road on the west and Dick's Creek on the south. Mr. Rinehart could not corroborate the movement of Dick's Creek material to this location.
  - A query in the Butler County Auditor Internet Web Site found that the owner/taxpayer of this property appears to be Garland II, LLC. The parcel is 3.7 acres, located at Yankee Road, PIN: Q6542101000005. The mailing address of Garland II, LLC, is 8300 Fields Ertel Road, Cincinnati, OH 45249. According to a query in Lexis-Nexis, People-

Finder records, there is a listing of (513) 489-9043 for Ronald Sorrell at the Cincinnati address. This listing could not be confirmed with telephone directory assistance.

- The general area of the this property is highlighted in violet on *Figure 2*.

- Mr. Rinehart recalls that material removed from Dick's Creek was also deposited at the southern end of property where the Burridge Machine Shop had been located. He said this is the same area that may now be a frozen foods business.
  - This facility now appears to be Schwan's Ice Cream and Finer Foods, 2910 Oxford State Road, Middletown, OH 45044, (513) 422-9950, according to an Internet Web query at www.smartpages.com. A photograph of this location is shown in *Figure 1*.
  - A query in the Butler County Auditor Internet Web Site found the following:
    - Schwans Consumer brands is the owner/taxpayer of 3.67 acres located at 2908 Oxford State Road, PIN: Q6542099000013;
    - Schwans Sales and Enterprises, Inc., is the owner/taxpayer of a second parcel of property consisting of 3.67 acres at 2908 Oxford State Road, PIN: C1720062000017.
    - The general area of the this property is highlighted in yellow on *Figure 2*.

- He said that material from Dick's Creek was also hauled to property known as a slag dumping area owned by Armco or AK Steel and located adjacent to and on the south side of the waterway. This area is located in the general vicinity to the south and southeast of where the Burridge Machine Shop was located. He recalled that there was an access road from the slag dumping area to Oxford State Road that trucks transporting spoils from the creek may have used. This road was near the east side of the machine shop property. The general area of this location is labeled on *Figure 2*. For all of the aforementioned properties identified by Mr. Rinehart, he could not provide more precise details as to where the material was deposited, the quantities moved, or how much of the particular work he witnessed.

- On November 12, 2004, CI Arkell left a telephonic voice mail message with Todd Kelchner concerning the worked performed by Kelchner Excavating, Inc. (50 Advanced Drive, Springsboro, OH 45066), at Dick's Creek in 1984. On November 16, 2004, Mr. Kelchner left two separate voice mail messages with CI Arkell. Mr. Kelchner stated that his father, Dick Kelchner, was the project manager for the work at Dick's Creek. Dick Kelchner passed away two years ago. Todd Kelchner was an estimator for the work they did at the waterway. He could not recall the extent that he was at the site when the work took place. He could not provide any information as to where material from Dick's Creek may have been placed. Other than himself, Kelchner Excavating does not currently employ anyone that would have been with the company 20 years ago. They do not have any records pertaining to the work that was done.

Figure 1 - Schwan's Ice Cream and Finer Foods, fka Burridge Machine shop.

Non-responsive

[redacted]

PERSONAL HISTORY

ARREST/INDICTMENT WITNESS INFORMANT COMPANY OTHER

XXXX

NAME (Last, First Middle) FILE NO.

[redacted] [redacted] [redacted]

ADDRESS PHONE

CITY, STATE ZIP

DATE OF BIRTH PLACE OF BIRTH SOCIAL SECURITY NO. EPA CII NO.

SEX [redacted] HEIGHT WEIGHT [redacted] EYES FBI NO.

[redacted]

[redacted] MARKS, TATTOOS

DRIVERS LICENSE NO. STATE EXPIRATION OTHER NUMBER

EMPLOYER AND [redacted] PHONE

[redacted] [redacted] [redacted]

OCCUPATION [redacted] NATIONALITY SUBSTANCE ABUSER **HAZARD**

ALIASES, NICKNAMES

CRIMINAL HISTORY/REMARKS (use additional sheets if necessary)

DATE OF ARREST/ INDICTMENT PLACE OF ARREST CHARGE

DISTRICT FED/STATE DISPOSITION

REPORTING AGENT DATE APPROVING OFFICIAL DATE

OFFICIAL USE ONLY

FOIA EXEMPT; PREPARED FOR SETTLEMENT PURPOSES ONLY; August 18, 2004; Revised September 20, 2004 (MCC comments in redline/underline 9/23/04)

Government Reaction to AK Steel's Flood Plain Sampling Proposal for Dicks Creek

Background:

Initial Government settlement proposal was sent to AK by OAG in February 2003. Item A.2. was an interim measure calling for a survey of the flood plain area, both banks, along the whole length of Dicks Creek Reaches 1 and 2. Work plans and sampling and analysis plans would be prepared by AK and approved, based on 40 CFR 761, Subpart N. We also stated that PCB cleanup levels in the flood plain would be 2 ppm, with confirmatory sampling to establish that cleanup levels have been achieved. Restoration would be achieved by adding clean fill. **AK's August 8, 2003, counter** did not accept any of the Government's initial settlement proposal.

AK asked about settlement during Gary Cygan's deposition, and outside counsel Mary Gade was assigned to explore on AK's behalf.

EPA updated past settlement proposal May 11, 2004, in preparation for meeting with OEPA on May 13, 2004, and meeting with AK on June 2, 2004. Expectations were that FP area west of MD (south bank) would be delineated and remediated for PCBs to 2.0 ppm and oils to no visible contamination. FP west of Yankee Road (north side) would be delineated and remediated to 2.0 ppm PCBs. Both areas would be restored with clean materials. Expectation was that further flood plain characterization would also be done both upstream and downstream of Yankee Road. Downstream areas identified as of concern included Excello area, Amanda School, and south bank of DC west of Yankee Road (channelized area). Upstream areas identified were: north side between Yankee and RR Bridge, area east of Outfall 002 on south side of DC where PCB and other seeps have occurred, old channel meander on N side of DC (begins about 100 feet upstream of YR). Remediation was not addressed as an interim measure, but under "additional work ".

AK offered on June 2, 2004 to remove PCB-impacted flood plain soil at 2 locations as identified below (See Figure 2 and samples S23 and S25). This was explained in AK's June 2, 2004, settlement proposal. No other flood plain sampling was proposed. EPA countered that we agreed these areas should be remediated plus we wanted a flood plain survey of other areas.

AK Steel has offered (6/16/04 proposal; 6/17/04 settlement meeting) to delineate and remove PCB containing > 5 ppm PCB flood plain soil at 2 previously identified locations in Reach 1 of the Dick's Creek flood plain in response to the government's request that these areas be removed. In addition, AK has offered to conduct further characterization (for PCBs and TOC) of the floodplain in both Reaches 1 (12 samples) and Reach 2 (12 samples), pursuant to a sampling and analysis plan to be submitted and approved in advance. Documents submitted in support of AK's proposal are as follows:

FOIA EXEMPT; PREPARED FOR SETTLEMENT PURPOSES ONLY; August 18, 2004; Revised September 20, 2004 (MCC comments in redline/underline 9/23/04)

June 16, 2004 Settlement Proposal for the Dick's Creek Area

Discussion:

EPA's initial reaction to AK's proposal was provided to AK at the 6/17/04 settlement meeting. This is summarized below.

AK has identified the first location to be remediated as EPA's sampling location **S25** (southside of the DC near Monroe Ditch) . It has identified the extent of contamination as encompassing approximately 50 square feet and 6 feet deep. EPA told AK it believes the extent of contamination is much more extensive, extending as far east as Monroe Ditch, and potentially further west than AK suspects. For example, EPA sample point S24 (west of sample S25) contained > 5 ppm total PCB congeners (less than 5 ppm Aroclors). AK has identified the depth of contamination at 6 feet. It may be deeper and characterization would need to delineate/confirm depth. This is a workplan issue. EPA asked for cleanup of PCBs in excess of 2 ppm; AK has proposed 5 ppm. This cleanup level issue is outstanding.

AK has identified the second location to be remediated as approximately 200 feet downstream of Yankee Road on the north side of DC near sampling location S23. This is an off-site floodplain area near the USGS monitoring station. EPA agrees that this area needs to be further delineated and the PCB contaminated soils removed. This is a workplan issue. EPA asked for cleanup of PCBs in excess of 2 ppm; AK has proposed 5 ppm. This cleanup level issue is outstanding.

AK has proposed additional FP sampling as identified above. AK proposed 0-2' depth. It was proposed by the government that samples in Reach 1 should be broken into 2 horizons initially: 0-1' and 1-2'. In Reach 2, we suggested the target depth could be 0-8". This was agreed upon. However, new information from MCD may require rethinking – see below.

Feedback provided by EPA at the August 18, 2004 meeting was as follows:

EPA has received more info from MCD that sheds light on areas of possible FP contamination. Hard copies of Attachments to Reggie Arkell's July 1, 2004, memo were provided to AK. They were told more documents were on the way and that these documents also needed to be considered to determine the spatial extent of sampling and that remediation of flood plain soils outside the previously identified areas also needed to be considered.

EPA provided this information to AK on September __, 2004. There were 3186 documents (6018 images) on one CD, and 352 documents (1239 images) on the second CD. EPA is concurrently reviewing the info on the CDs.

FOIA EXEMPT; PREPARED FOR SETTLEMENT PURPOSES ONLY; August 18, 2004; Revised September 20, 2004 (MCC comments in redline/underline 9/23/04)

Current Suggested Government Proposal for Discussion:

The flood plain in the channelized area (especially between Sta 0+00 and Sta 60+00) has been heavily impacted by past disposal operations from dredging based on the MCD documents received. Much of the dredge spoils from past dredging of Reach 1 was "panned" onto the flood plain and upland areas adjacent to Dicks Creek, based on the MCD records. This warrants a much more intensive flood plain survey for PCBs in Reach 1, due to the higher potential to find PCB contaminated soils than previously envisioned based on the past conceptual model of PCB releases from point sources only. All areas of the flood plain within (and upstream of) Reach 1 need more extensive characterization. This sampling can be girdled out by AK based on 40 CFR Part 761, ~~Appendix~~ Subpart N, in a sampling and analysis work plan and associated quality assurance project plan. (Subpart N at 40 CFR 761.260 says to use a grid interval of 3 meters which is probably much to intensive and expensive. Using a 25 x 25 foot grid system with samples at the corners and composite sample from within the square may still be too much.) This effort can be combined in a single work plan with the sediment characterization planned as an interim measure. EPA has previously agreed to allow AK to use EPA Method 680 with pressurized fluid extraction (Method 3545) as the analytical method. In light of the number of samples expected, it may be prudent to require some percentage of either Aroclor or congener testing for confirmation. It is noted that the flood plain samples did not reflect a specific single Aroclor pattern (see results for samples S23 and S25/S28) and are more than likely a combination of at least Aroclors 1242 and 1248, which are difficult to quantitate when present together (many common congeners in mid-range). Therefore, the best method for confirmation is via specific congener analysis. (As an alternative, perhaps the NOAA 18 congeners can be analyzed and a ratio developed to total PCBs; needs further discussion as to how to do this.) (Aroclor confirmation sampling would be much more practical. If the Homolog and Aroclor results vary widely, the lab would be required to investigate the results, explain them and take appropriate analytical corrective actions that may include retesting some samples. All this would subject to EPA approval.) The specific areas needing characterization within or upstream of Reach 1 are as follows (nomenclature is by EPA):

Area A: downstream of Yankee Road, south side DC, to terminus of channelized area; (Is this area across from sample S23 ?? Dredge spoils were probably spread on both sides of the DC at this location. How wide is the floodplain on both sides of DC here? What grid interval would we use here? Should we use 10 foot grid for known hot spots and 25 foot grid for other characterization areas?)

Area B: upstream of Yankee Road, north side DC, to RR bridge (area owned by AK);
Area D: north side of DC, upstream of RR Bridge to approximately station 19+00 (area partially owned by AK);
Area E: old channel spoil area, north side of DC, from approximately station 19+50 to station

25+00 (south of Seneca and Ottawa Streets extended), depth of samples needs to be greater, perhaps to 10 feet;

Area F: north side of DC, upstream of Area E to slag hauler road (approximate station 48+50);

(Areas B, D, E and F appear to be the entire north side of DC from Yankee Rd Sta 0+00 to the slag hauler road Sta 48+50. Is there a reason to break them out this way? Gary Cygan indicated that the flood plain was 75 to 50 feet wide along the north side of DC and 4,000 to 5,000 feet long. Is the FP area to be grid sampled 75 by 5,000 feet? If we used a 25 foot grid system and apply to 5,000 feet you get 200 transects with 6 samples per transect (3 at the surface and 3 at some depth) equals 1,200 total samples time $200/sample equals $240,000. Or are we going to spread our samples withing the entire area bounded by Yankee Rd, Oxford State Rd, slag haul road , and north side of DC.?)

Area C: upstream of Yankee Road, south side, to remediation area of S25 (area owned by AK);
Area G: south side of DC, from upstream of Monroe Ditch to approximately station 39+00;
Area H: south side of DC, old channel meander area from about station 39+00 to about station 49+00 (depth of samples needs to be greater, perhaps to 10 feet).

(Areas C, G and H are the entire southside of DC from Yankee Rd Sta 0+00 to Sta 49 (same as the northside.). Is there a reason to break them out this way? Gary Cygan indicated that the FP on the southside is 5 to 10 feet wide. Would the FP sampling grid area be 10 by 5000 feet? Using 25 foot transects, used get 200 transects with 2 samples per transect (1 at the surface and 1 at some depth) equals 400 total samples time $200/sample equals $80,000.)

Areas in Reach 2: AK proposed sampling 12 locations in the flood plain between Yankee Road and Main Street, 6 on each side of DC. No information is available to indicate MCD dredged spoils were placed in these locations. The governments should accept this proposal, subject to work plan development.

(Six samples on each side of the DC in Reach 2 is not very many for such a large area, about 1.5 miles) . While no dredging or spoils disposal has occurred in Reach 2 that we know of to date, we still need to determine if the floodplain sediment is contaminated with PCBs, especially the north side of DC. It seems to me that we needs to make sure the floodplain in Reach 2 is not a PCB sink. As I understand things, there has been flooding over the years that has reached the Amanda School and Amanda neighborhood. How wide is the floodplain on both sides of DC in Reach 2?? If the southside Reach 2 FP appears to be higher in elevation, maybe we can focus more characterization work on the northside FP.??

Are we still seeking more Reach 2 stream sediments characterization, especially at depth?? We can combine this work with the Reach 2 FP sampling. Say that the area is around 5,000 feet in length and we use a 50 foot transects we get 100 transects. Per one transect, we would have one sample of creek sediment at depth, 3 samples from the FP on the northside and 2 samples on of the FP on the southside, 100 transects times 6 samples/transect times $200/sample equals $120,000)

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October 5, 2004

<u>Government Reaction to AK Steel's Flood Plain Sampling Proposal for Dicks Creek</u>

Reach 1

The flood plain in the channelized area has been heavily impacted by past disposal operations from dredging based on the MCD documents received (Stations -4+00 (approximate) to Station 60+00). Some of the dredge spoils from past dredging of Reach 1 was disposed of or "panned" onto the flood plain and upland areas adjacent to Dicks Creek, based on the MCD records. The remainder was moved to designated upland disposal areas. This localized disposal method warrants a much more intensive flood plain survey for PCBs in Reach 1 than proposed by AK, due to the higher potential to find PCB contaminated soils than previously envisioned based on the past conceptual model of PCB releases from point sources only. All areas of the flood plain within (and upstream of) Reach 1 (to Slag Hauler Road) need more extensive characterization. This sampling can be gridded out by AK in a sampling and analysis work plan and associated quality assurance project plan, and implemented this fall. (If appropriate, this effort can be combined in a single work plan with the sediment characterization planned as an interim measure.) EPA has previously agreed with AK to use EPA Method 680 coupled with Method 3545 (pressurized fluid extraction) as the analytical methods. The target depths for analyses are 0-1 foot and 1-2 feet, except as identified below. Number and locations of samples in a given area (as described below) are a work plan issue and are dependent upon the width of the flood plain and on information currently known about that area (e.g. known disposal area, downstream of PCB sources, etc.). Past sample locations and results should be included in the work plan for planning purposes. The specific areas EPA has identified as needing detailed characterization within or upstream of Reach 1 are as follows (nomenclature is by EPA):

Area A: downstream of Yankee Road, both sides of DC, to terminus of channelized area or **S23** remediation area (approximately 400 feet by 60 feet each side);
Area B: upstream of Yankee Road, north side DC, to RR bridge (area owned by AK, approximately 900 feet by 75 feet), see Figure 1;
Area C: upstream of Yankee Road, south side, to remediation area of **S25** (area owned by AK, approximately 50 feet wide to west end of **S25** remediation area);
Area D: north side of DC, upstream of RR Bridge (approximate station 9+00) to approximately station 19+00 (area partially owned by AK; width of FP varies, approximately 1000 lf), see Figure 2;
Area E: old channel spoil area, north side of DC, from approximately station 19+00 to station 25+00 (south of Seneca and Ottawa Streets extended), depth of samples needs to be greater, perhaps to 10 feet, area of about 400 feet deep by 600 feet, see Figure 3;
Area F: north side of DC, upstream of Area E (approximate station 25+00) to slag hauler road (approximate station 48+50) (area partially owned by AK; width of FP varies, approximately 2,350 lf);
Area G: south side of DC, from upstream of Monroe Ditch to approximately station 39+00 (area

owned by AK; width of FP varies, approximately 2,900 lf);

Area H: south side of DC, old channel meander area from about station 39+00 to about station 48+00, depth of samples needs to be greater, perhaps to 10 feet, area of about 400 feet deep by about 900 feet.

Figures 1, 2 and 3 show possible work plan configurations for sampling in Areas B, D and E, respectively. Sampling locations should be determined by grid lines both parallel and perpendicular to the river. Area B is more than likely a past spoil disposal area, and is likely to be contaminated. Area D is unknown as to contamination status, but past samples showed less than 5 ppm PCBs. Area E is an old stream meander which was filled in, which may be contaminated both at the surface and at depth. These three areas are typical of all areas to be characterized in Reach 1.

Reach 2:

AK proposed sampling 12 locations in the flood plain between Yankee Road and Main Street, 6 on each side of DC. No information is available to indicate MCD dredged spoils were placed in these locations. The government is willing to agree to a less detailed characterization in this area, perhaps a spacing of up to 500 feet between samples, but a greater density of samples should be located adjacent to Excello and Amanda School. The specific locations are a work plan issue, but this may result in about 40 samples total in this area; 15 on the south side and 25 on the north side. EPA has previously agreed with AK to use EPA Method 680 coupled with Method 3545 (pressurized fluid extraction) as the analytical methods. The target depth for analyses is 0-8 inches. Any past flood sample locations and results should be included in the work plan for planning purposes.

Remediation of Flood Plain Areas:

The plaintiffs agree with AK that the flood plain areas identified in its June 16th settlement proposal need to be delineated and remediated. Comments are included below.

AK identified the first location to be remediated as EPA's sampling location **S25** (south side of DC near Orman's Welding just west of MD). It has identified the extent of contamination as encompassing approximately 50 square feet and 6 feet deep. EPA believes the extent of contamination is more extensive, extending as far east as Monroe Ditch, and potentially further west than AK suspects since EPA sample point **S24** (west of sample **S25**) contained > 5 ppm total PCB congeners (less than 5 ppm Aroclors). AK has identified the depth of contamination at 6 feet. AK should recognize the contamination may be deeper and characterization would need to delineate/confirm depth. This is a work plan issue. EPA asked for cleanup of PCBs in excess of 2 ppm; AK has proposed 5 ppm. EPA is willing to agree to the 5 ppm cleanup level.

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October 5, 2004

AK identified the second location to be remediated as the location of EPA sample point **S23**, located on the north side of DC, approximately 200 feet downstream of Yankee Road. (Sample point **S23** is actually about 350 feet downstream of Yankee Road.). This is an off-site flood plain area near the USGS monitoring station. EPA agrees that this area needs to be further delineated and the PCB contaminated soils removed. This is a work plan issue. EPA asked for cleanup of PCBs in excess of 2 ppm; AK has proposed 5 ppm. EPA is willing to agree to the 5 ppm cleanup level.

Depending on the results of the flood plain characterization, EPA expects that AK would agree to delineate and remediate other flood plain areas with PCBs greater than 5 ppm, either as part of the interim measures of as part of the long term corrective action.

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October 6, 2004

Government Reaction to AK Steel's Flood Plain Sampling Proposal for Dicks Creek

Reach 1

The flood plain in the channelized area has been heavily impacted by past disposal operations from dredging based on the MCD documents received (Stations -4+00 (approximate) to Station 60+00). Some of the dredge spoils from past dredging of Reach 1 was disposed of or "panned" onto the flood plain and upland areas adjacent to Dick's Creek, based on the MCD records. The remainder was moved to designated upland disposal areas. This localized disposal method warrants a much more intensive flood plain survey for PCBs in Reach 1 than proposed by AK, due to the higher potential to find PCB contaminated soils than previously envisioned based on the past conceptual model of PCB releases. All areas of the flood plain within (and upstream of) Reach 1 (to Slag Hauler Road) need more extensive characterization.

The specific areas EPA has identified as needing detailed characterization within or upstream of Reach 1 are as follows (nomenclature is by EPA):

Area A: downstream of Yankee Road, both sides of DC, to terminus of channelized area or **S23** remediation area (approximately 400 feet by 60 feet each side);
Area B: upstream of Yankee Road, north side DC, to RR bridge (area owned by AK, approximately 900 feet by 75 feet), see Figure 1;
Area C: upstream of Yankee Road, south side, to remediation area of **S25** (area owned by AK, approximately 50 feet wide to west end of **S25** remediation area);
Area D: north side of DC, upstream of RR Bridge (approximate station 9+00) to approximately station 19+00 (area partially owned by AK; width of FP varies, approximately 1000 lf), see Figure 2;
Area E: old channel spoil area, north side of DC, from approximately station 19+00 to station 25+00 (south of Seneca and Ottawa Streets extended), depth of samples needs to be greater, perhaps to 10 feet, area of about 400 feet by 600 feet, see Figure 3;
Area F: north side of DC, upstream of Area E (approximate station 25+00) to slag hauler road (approximately station 48+50) (area partially owned by AK; width of FP varies, approximately 2,350 lf);
Area G: south side of DC, from upstream of Monroe Ditch to approximately station 39+00 (area owned by AK; width of FP varies, approximately 2,900 lf);
Area H: south side of DC, old channel meander area from about station 39+00 to about station 48+00, depth of samples needs to be greater, perhaps to 10 feet, area of about 400 feet by about 900 feet.

Details of the floodplain sampling project should be addressed in a sampling and analysis workplan and associated quality assurance project plan. EPA has previously agreed with AK to use EPA Method 680 coupled with Method 3545 (pressurized fluid extraction) as the analytical methods. The specific number and locations of samples in each of the above-referenced areas are work plan issues and are dependent upon the width of the flood plain and on information currently known about that area (e.g. known disposal area, downstream of PCB sources, etc.).[1] However, to provide some general guidance for the preparation of acceptable work plans, EPA has considered possible configurations for sampling efforts in various areas identified above. A summary of these configurations is set forth below.

As an initial matter, except as noted below, at each sampling location, floodplain characterization efforts should provide information about PCB concentrations at two depth intervals (0-1 foot and 1-2 feet). Figures 1, 2 and 3 show possible work plan configurations for sampling in Areas B, D and E, respectively. Area B is more than likely a past spoil disposal area, so the suggested sampling configuration in Figure 1 reflects a level of effort that is appropriate for an area where contamination is likely to be present. Because Area E is a former stream meander (now filled in), which may be contaminated both at the surface and at depth, Figure 3 suggests a sampling configuration designed to provide information about contamination that may remain in the former stream channel. To this end, sampling in Area E should include a third depth interval that will characterize contaminant levels in the former stream channel. Finally, Area D represents an area where present contamination status is unknown, but past samples showed less than 5 ppm PCBs. As indicated in Figure 2, the proposed sampling configuration for Area D contemplates a larger sampling interval than used in areas where available information suggests a higher probability of contamination.

In general, the type of sampling configuration suggested for Area B could be adapted for use in Areas A and C, while the type of configuration proposed for Area D could be adapted for use in Areas F and G. In areas where the floodplain is very narrow, a single transect may be sufficient, but generally at least two transects are anticipated in such areas. In area H, another former meander area, a sampling configuration could be developed using an approach similar to that suggested for Area E.

Reach 2:

AK proposed sampling 12 locations in the flood plain between Yankee Road and Main Street, 6 on each side of DC. No information is available to indicate MCD dredged spoils were placed in these locations. The government is willing to agree to a less detailed characterization in this area, perhaps a spacing of up to 500 feet between samples, but a greater density of samples should be located adjacent to Excello trailer park and Amanda School. The specific locations are a work plan issue, but this may result in about 40 samples total in this area; 15 on the south side

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[1] Past sample locations and results should be included in the work plan for planning purposes.

and 25 on the north side. EPA has previously agreed with AK to use EPA Method 680 coupled with Method 3545 (pressurized fluid extraction) as the analytical methods. The target depth for analyses is 0-8 inches. Any past flood sample locations and results should be included in the work plan for planning purposes.

To assure that the floodplain will not serve as a source of recontamination of Dick's Creek following cleanup of Creek sediments, it is important to complete characterization of floodplain contaminants prior to cleanup of Dick's Creek. To avoid delays that could prevent completion of the Creek cleanup next season, workplans should be submitted to EPA as soon as possible, and characterization work undertaken this fall.

Remediation of Flood Plain Areas:

The plaintiffs agree with AK that the flood plain areas identified in its June 16th settlement proposal need to be delineated and remediated. Comments are included below.

AK identified the first location to be remediated as EPA's sampling location **S25** (south side of DC near Orman's Welding just west of MD). It has identified the extent of contamination as encompassing approximately 50 square feet and 6 feet deep. EPA believes the extent of contamination is more extensive, extending as far east as Monroe Ditch, and potentially further west than AK suspects since EPA sample point **S24** (west of sample **S25**) contained > 5 ppm total PCB congeners (less than 5 ppm Aroclors). AK has identified the depth of contamination at 6 feet. AK should recognize the contamination may be deeper and characterization would need to delineate/confirm depth. This is a work plan issue. EPA asked for cleanup of PCBs in excess of 2 ppm; AK has proposed 5 ppm. EPA is willing to agree to the 5 ppm cleanup level.

AK identified the second location to be remediated as the location of EPA sample point **S23**, located on the north side of DC, approximately 200 feet downstream of Yankee Road. (Sample point **S23** is actually about 350 feet downstream of Yankee Road.). This is an off-site flood plain area near the USGS monitoring station. EPA agrees that this area needs to be further delineated and the PCB contaminated soils removed. This is a work plan issue. EPA asked for cleanup of PCBs in excess of 2 ppm; AK has proposed 5 ppm. EPA is willing to agree to the 5 ppm cleanup level.

Depending on the results of the flood plain characterization, EPA expects that AK would agree to delineate and remediate other flood plain areas with PCBs greater than 5 ppm, either as part of the interim measures of as part of the long term corrective action.

Non-responsive

[redacted]

Non-responsive

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Non-responsive

[redacted]

ATTY - CLIENT PRIVILEGE
FOIA EXEMPT

Technical Memorandum

For Internal Discussion Only

Date: 10/06/04

From: Bhooma Sundar, Toxicologist
Corrective Action Section, ECAB, WPTD

To: Robert Guenther
Associate Regional Counsel, ORC

Subject: Derivation of Sediment Cleanup Goal for Dick's Creek, Reach 2

This memorandum is provided in response to the conference calls on 8/20/04 and 9/16/04 between DOJ and the EPA Region 5 RCRA AK Steel case management team. I was asked to develop a Sediment Cleanup Goal for protection of human health in a stepwise fashion. This included calculating a biota/sediment accumulation factor (BSAF) for fish and developing a cleanup goal for Total PCBs in sediment that provides a direct link between fish consumption rate and risk levels. The data for the derivation of Sediment Cleanup Goals was obtained from selected tables in the human health risk assessment (DeGrandchamp, 2003) and ecological risk assessment (Barron, 2003) reports prepared for EPA for the litigation.

Summary

Biota/sediment accumulation factor calculations (BSAF) were performed to determine the impact of certain levels of PCBs, if allowed to remain in Dicks Creek sediment, on risk levels for both cancer causing and non-cancer causing situations. The BSAF calculations were determined using Aroclor PCB data for fish collected by EPA in July 2002 (fish tissue) and March 2003 (sediments, TOC). Furthermore, the calculations were done using averages for both the entire reach, river mile 1.7 to 2.8, and again using the average from calculations involving individual fish samples. The following Tables identify sediment cleanup goals for different scenarios targeting an excess cancer risk of 1 x 10 –5 and a non cancer health end point hazard quotient of 1 for total PCB Aroclors.

Table 1: Sediment cleanup goal(mg/kg) for PCB- Aroclors based on sediment Geometric mean and BASF calculated from Sediment Average

Exposure Assumptions	Fish Screening value (mg/Kg)		BSAF	Cancer risk (1in 100,000)	Hazard Quotient (1)
	Cancer	Noncancer			
Scenario 1	0.02	0.08	0.30	0.03	0.11
Scenario 2	0.11	0.17	0.30	0.16	0.43
Scenario 3	0.71	0. 95	0.30	**1.01**	**1.36**
Scenario 4	0.21	0.27	0.30	**0.30**	**0.38**

Table 2: Sediment cleanup goal(mg/kg) for PCB- Aroclors based on geometric mean of individual fish BSAF data

Exposure Assumptions*	Fish Screening value (mg/Kg)		BSAF	Cancer risk (1in 100,000)	Hazard Quotient (1)
	Cancer	Noncancer			
Scenario 1	0.02	0.08	0.26	0.03	0.13
Scenario 2	0.11	0.17	0.26	0.18	0.27
Scenario 3	0.71	0. 95	0.26	**1.17**	**1.56**
Scenario 4	0.21	0.27	0.26	**0.35**	**0.45**

* Foot note:

1. Scenario 1 - Fish tissue PCB concentration as recommended by Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Vol 1.

2. Scenario 2: Fish tissue PCB concentration based on the fish tissue ingestion rate of 17g/day exposure assumptions described in Dicks Creek HHRA, Degrandchamp, 2003.

3. Scenario 3: Fish tissue PCB concentration based on the fish tissue ingestion rate of 1.5 g/day as per Dr.Degrandchamp's rebuttal on comments, 2004.

4. Scenario 4: Fish tissue PCB concentration based on the fish tissue ingestion rate of 5.25 g/day exposure assumptions described in Dicks Creek HHRA, Arcadis, 2003

Recommendations

Results indicate that a PCB concentration of up to 1.2 ppm may be allowed to remain in Dicks Creek sediment in order to achieve a conservative cancer risk of 1x10-5 and a comparable non cancer health end point. Using geometric mean, similar sediment cleanup goal was obtained both for "reach average" method driven BSAF and individually computed fish BSAF. Please refer to uncertainty analysis for additional assumptions affecting these results.

The EPA or state recommended fish tissue PCB levels in fish advisories could be used as a guiding factor in choosing the most reasonable cleanup goal. As per Table 2 of the FACT sheet on PCBs update(Office of Water, EPA-823-F-99-019), 2ppb of PCB (EPA recommended screening criteria) in fish tissue allows 16 meals/month, while 11 ppb (Dick's creek HHRA exposure assumptions) allows 4 fish meals/month for cancer health end point. As per the derived BSAF, a sediment PCB concentration of 1.0 to 1.4 ppm would be equivalent to fish PCB tissue concentration of 770 ppb to 980 ppb.

Discussion

Region 5 has developed a methodology to calculate Sediment Cleanup Goal (SCG) using lipid and TOC (Total Organic Carbon) normalized BSAF. The following steps are involved in developing SCG.

1. Set acceptable contaminant level in fish (SV)

2. Determine total organic carbon (TOC) in sediment
3. Determine lipid content of fish
4. Calculate BSAF
5. Calculate the Sediment Cleanup Goal (SCG)

Step 1: Set Acceptable Contaminant level in fish

The following table provides four scenariosw

Exposure Assumptions	Unit	Scenario 1[1]	Scenario 2[2]	Scenario 3[3]	Scenario 4[4]
Fish consumption(CR)	g/day	17	17	1.5	5.25
Exposure frequency(EF)	days		365	365	365
Exposure duration (ED)	year		24	24	24
Body Weight (BW)	Kg	70	70	70	70
Averaging time (AT)	days				
Cancer			25,560	25,560	25,560
Noncancer			8,760	8,760	8,760
Fish screening value[5]	mg/kg				
Cancer (1e-5)		0.02	0.11	0.71	0.21
Noncancer (HQ = 1)		0.08	0.166	0.95	0.270

1. Scenario 1 - Fish tissue PCB concentration as recommended by Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Vol 1.

2. Scenario 2: Fish tissue PCB concentration based on the fish tissue ingestion rate of 17g/day exposure assumptions described in Dicks Creek HHRA, Degrandchamp, 2003.

3. Scenario 3: Fish tissue PCB concentration based on the fish tissue ingestion rate of 1.5 g/day as per Dr.Degrandchamp's rebuttal on comments, 2004.

4. Scenario 4: Fish tissue PCB concentration based on the fish tissue ingestion rate of 5.25 g/day exposure assumptions described in Dicks Creek HHRA, Arcadis, 2003

Human health risk assessment was the basis for selecting appropriate PCB contamination level in fish. Dr.Richard DeGrandChamp suggested during the conference call that a EPA recommended screening value of 0.02 ppm in fish tissue be used in the calculation of SCG(Scenario 1) . This screening value (SV) relates to a risk level corresponding to one excess case of cancer per 100,000 individuals exposed over a 70- yr lifetime.

The following equation was used in calculating the EPA recommended screening criteria

[(1x10-5/2 kg- d/mg) * 70 kg]/0.017kg/d = 0.02 mg/kg

The above equation however, does not take in to account the other exposure assumptions such as exposure frequency, exposure duration and fraction of fish PCB ingested in calculating average daily intake. To compensate this deficiency, three site specific screening values for total PCB in fish was calculated using fish ingestion assumptions according to HHRA for Dick's Creek (EPA,2003), Dr.Degrand Champ's revised ingestion rate based on noncancer health effect of dioxin and HHRA for Dick's Creek (Arcadis, 2002) involving adult recreational receptor scenario.
The following equation was used in calculating daily intake.

Daily Intake = CR*EF*ED*CF*F*(1/BW)*(1/ATc)

Step 2: Determine TOC in Sediments

Sediment ID	River mile	TOC-fraction
S03	1.63	0.021
S04	1.7	0.013
S05	1.87	0.006
S06	2	0.005
S07	2.45	0.009
S09	2.64	0.005
S10	0.01	0.006
S11	0.35	0.014
S12	2.76	0.008
S13	2.81	0.008

The W test conducted to study the data distribution showed a lognormal distribution. Thegeometric mean of Sediment TOC is 0.009.

Step 3: Determine lipid content of fish

Fish ID	Lipid Fraction
F01	0.033
F02	NC
F03	0.01
F04	0.02
F05	0.025
F06	0.018
F07	NC
F08	0.017
F09	0.013
F10	0.03

The W test conducted to study the data distribution showed a normal distribution. The arithmetic mean of fish tissue lipid is 0.021.

Step 4: Calculate BSAF

BSAF is defined as " the ratio of a substance's lipid-normalized concentration in tissue of an aquatic organism to its organic carbon normalized concentration in surface sediment, in situations where the ratio does not change substantially over time, both the organism and its food are exposed and the surface sediment is representative of average surface sediment in the vicinity of the organism."

PCB levels and the respective BSAF of individual fish

Fish Type	River mile	Lipid Fraction	Total PCB Aroclors mg/kg ww	Total PCB Congeners mg/kg ww	BSAF Total PCB Aroclors	BSAF Total PCB Congeners
Common Carp	2.8	0.033	3.2	18.5	0.22698	1.7939
Smallmouth Bass	2.8	NC	1.3	4.21	NC	NC
Channel Catfish	2.8	0.01	0.6	3.22	0.118919	1.0304
Channel Catfish	2.5	0.02	0.9	3.79	0.024196	0.044882
Channel Catfish	2.5	0.025	1.0	2.43	0.020442	0.023021
Common Carp	2.5	0.018	3.6	11.1	0.10603	0.14603
Smallmouth Bass	1.7	NC	0.7	4.16	NC	NC
Flathead Catfish	1.7	0.017	2.6	10.1	3.285846	6.4362
Channel Catfish	1.7	0.013	3.8	11.1	6.90625	9.25
Common Carp	1.7	0.03	4.0	12.9	3.25	4.65833

BSAF = ($Cb*f_{OC}$)/($Cs*f_{lipid}$) where

BSAF = Biota/Sediment Accumulation factor (g carbon/ g lipid)
Cb = Organism concentration at steady state (mg/kg wet wt)
f_{lipid} = fractional lipid contents of the tissues (g/g wet wt)
Cs = Contaminant concentration in the sediments (mg/Kg dry wt)
f_{OC} = fractional organic carbon contents of the sediments (g/g dry wt)

The above table summarizes the PCB level, lipid fraction and the respective BSAF in individual fishes caught with in the reach. Based on the reach length ranging from 0.3 to 2.8 river mile, BSAF was calculated by averaging the concentration of aroclor based PCBs in the sediment. The W test conducted to study the data distribution showed a lognormal distribution. The geometric mean value of sediment PCB-Aroclor was determined to be 3.17mg/kg and as per normal distribution of fish PCB aroclor data, the arithmetic mean was found to be 2.2 mg/kg.

Thus based on a reach average,
$BSAF_{PCB\text{-}Arocolors}$ = (2.2 mg/kg * 0.009)/(3.17 mg/kg *0.021) = 0.30

Based on BSAF calculated from individual fish obtained with in the entire segment of reach, the geometric mean of BSAF for fish PCB Aroclor is 0.261.

Step 5 : Calculate Sediment Cleanup Goal (SCG)

The following table provides the statistical summary of sediment and fish data distribution.

Parameter	n	Distribution	Geometric Mean	Arithmetic mean	Standard Deviation	MVUE
Sediment						
PCB-Aroclor	10	Lognormal	3.17		3.78	6.69
TOC	10	Lognormal	0.009		1.614	0.009
Fish						
PCB- Aroclor	10	Lognormal	1.72	2.2 (1.4)	2.13	2.2
Lipid	8	Normal		0.021	0.008	0.021
BSAF	8	Lognormal	0.261		10.1	1.82
BSAF(non normalized)	8	Lognormal	0.511		6.64	2.137

MVUE – Minimum variance of unbiased estimate

The sediment cleanup goal was calculated as below

SCG = ($Cb*f_{OC}$)/($BSAF*f_{lipid}$) where

SCG = Contaminant concentration in the sediments (mg/Kg dry wt)
Cb = Organism concentration at steady state (mg/kg wet wt)
f_{OC} = fractional organic carbon contents of the sediments (g/g dry wt)
BSAF = Biota/Sediment Accumulation factor (g carbon/ g lipid)
f_{lipid} = fractional lipid contents of the tissues (g/g wet wt)

Sediment cleanup goal(mg/kg) for PCB- Aroclors based on sediment Geometric mean and BASF calculated from Sediment Average

Exposure Assumptions	Fish Screening value (mg/Kg)		BSAF	Cancer risk (1in 100,000)	Hazard Quotient (1)
	Cancer	Noncancer			
Scenario 1	0.02	0.08	0.30	0.03	0.11
Scenario 2	0.11	0.17	0.30	0.16	0.43
Scenario 3	0.71	0. 95	0.30	**1.01**	**1.36**
Scenario 4	0.21	0.27	0.30	**0.30**	**0.38**

Sediment cleanup goal(mg/kg) for PCB- Aroclors based on geometric mean of individual fish BSAF data

Exposure Assumptions*	Fish Screening value (mg/Kg) Cancer	Noncancer	BSAF	Cancer risk (1in 100,000)	Hazard Quotient (1)
Scenario 1	0.02	0.08	0.26	0.03	0.13
Scenario 2	0.11	0.17	0.26	0.18	0.27
Scenario 3	0.71	0. 95	0.26	**1.17**	**1.56**
Scenario 4	0.21	0.27	0.26	**0.35**	**0.45**

* Foot note:

1. Scenario 1 - Fish tissue PCB concentration as recommended by Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Vol 1.

2. Scenario 2: Fish tissue PCB concentration based on the fish tissue ingestion rate of 17g/day exposure assumptions described in Dicks Creek HHRA, Degrandchamp, 2003.

3. Scenario 3: Fish tissue PCB concentration based on the fish tissue ingestion rate of 1.5 g/day as per Dr.Degrandchamp's rebuttal on comments, 2004.

4. Scenario 4: Fish tissue PCB concentration based on the fish tissue ingestion rate of 5.25 g/day exposure assumptions described in Dicks Creek HHRA, Arcadis, 2003

How the projected numbers in the summary column compare with other clean up sites:

The SCG was calculated similar to the approach for human health SCGs used by State of Washington for Hylebos Waterway, Commencement Bay, Near Shore/Tide Flats superfund site. 0.5 ppm in sediments has been selected as an appropriate human health clean up goal, based on the consumption of bass under the reasonable maximum exposure conditions which equals 1 in ten thousand risk. The corresponding BSAF for bass based on which the SCG was derived is 4.54 with a total lipid content of 0.715% and a geometric mean on the organic carbon content of sediment at 5.3%.

Uncertainty Analysis

In the absence of information such as fish life-history and home range and the contaminant of concern (COC) bioconcentration with fish size or age, it is difficult to accurately interpret BSAF results. Further, it is uncertain that the fish were collected at the site representative of long-term, steady- state bioaccumulation. In light of the above uncertainties regarding the BSAF calculation, it is possible that the projected sediment cleanup goal may be slightly underestimating or overestimating risk. However, chlorinated chemicals such as PCBs and PCDs having large Kows and low metabolism rates tend to provide more reliable BSAFs than chemicals like PAHs which have higher rates of metabolism.

The sediment cleanup criteria focuses only on fish ingestion of PCB alone. Other potential exposure pathways such as dermal contact and ingestion of sediment are not included in this derivation. Further, other potential contaminants such as PAH are not analyzed in this study. Thus the cancer risk due to sediment contamination on human health is slightly under estimated in this report.

The sediment cleanup goal targets the recreational adult receptor who consumes fish at a level of 17g/ day as the highest level of consumption and projects the cleanup goal for even lesser consumption rate. By not calculating worst case scenario which is reasonable maximum consumption which is 54g/dayfor recreational fishermen, the projected summary may underestimate the cancer risk and noncancer hazard associated with current contamination in sediment.

By following EPA recommended screening value for PCB level in fish tissue, the risk is slightly overestimated by not considering assumptions regarding fish- preparation. In other words, it is assumed that 100% of fish tissue is ingested.

Addendum

As per DOJ's request on 9/29/04, the tables were recalculated to derive a sediment cleanup goal that focused on sediment PCB and fish tissue PCB without normalizing for either sediment TOC or fish tissue lipid concentration.

Sediment cleanup goal(mg/kg) for PCB- Aroclors based on sediment Geometric mean and BASF calculated from Sediment Average

Exposure Assumptions	Fish Screening value (mg/Kg)		BSAF	Cancer risk (1in 100,000)	Hazard Quotient (1)
	Cancer	Noncancer			
Scenario 1	0.02	0.08	0.776	0.025	0.10
Scenario 2	0.11	0.17	0.776	0.141	0.212
Scenario 3	0.71	0. 95	0.776	**0.91**	**1.18**
Scenario 4	0.21	0.27	0.776	**0.270**	**0.34**

Sediment cleanup goal(mg/kg) for PCB- Aroclors based on geometric mean of individual fish BSAF data

Exposure Assumptions*	Fish Screening value (mg/Kg)		BSAF	Cancer risk (1in 100,000)	Hazard Quotient (1)
	Cancer	Noncancer			
Scenario 1	0.02	0.08	0.511	0.04	0.16
Scenario 2	0.11	0.17	0.511	0.21	0.33
Scenario 3	0.71	0. 95	0.511	**1.39**	**1.86**
Scenario 4	0.21	0.27	0.511	**0.41**	**0.53**

* Foot note:

1. Scenario 1 - Fish tissue PCB concentration as recommended by Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Vol 1.

2. Scenario 2: Fish tissue PCB concentration based on the fish tissue ingestion rate of 17g/day exposure assumptions described in Dicks Creek HHRA, Degrandchamp, 2003.

3. Scenario 3: Fish tissue PCB concentration based on the fish tissue ingestion rate of 1.5 g/day as per Dr.Degrandchamp's rebuttal on comments, 2004.

4. Scenario 4: Fish tissue PCB concentration based on the fish tissue ingestion rate of 5.25 g/day exposure assumptions described in Dicks Creek HHRA, Arcadis, 2003

To: R Darnell
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Dredge Spoil Disposal Areas

Dredging and/or channelization has taken place in 1967, 1975, 1976 and 1984 from point 400 feet west/downstream of Yankee Rd bridge to upstream/east of Yankee Rd bridge to Sta 150+00 (intersection of North Branch of DC and main DC). (We know that Armco/AK had at least 57 PCB transformers in 1977. Many of these had probably been there for 20 to 30 years prior. Beginning in 1983, Armco/AK began disposing of PCBs transformers, which was completed around 1999. We do not know the first use date for PCBs hydraulic oil at the Middletown works. We do know that Armco purchased 990,000 pounds of Monsanto-brand hydraulic oil between 1970 and 1972. I believe PCB hydraulic oil use began in the mid 1950's.)

1967
The 1967 dredging/channelization between Sta 0+00 to Sta 50+00 straightened the creek by pushing the sediments onto the existing creek-banks and/or floodplain areas. This dredging also isolated two large meanders located at Sta 19+00---Sta 25+00 and Sta 38+00---Sta 48+00. An estimated 100,000 cubic yards of creek sediments east of Sta 50 to Sta 150 were also removed to onsite Armco fill areas (see MCC 9/1/04 revised Contract Map 142). As part of Corrective Action (CA), we should require AK to sample several of these open onsite fill areas to determine if PCBs are present. We may want to require 25 to 30 of "discretionary samples" that are chosen by EPA for this purpose and sampled/tested by AK.

1975 and 1976
The extent of dredging work done in 1975 and 1976 and the location of dredge spoil disposal areas are unknown at this time.

1984
In 1984, several areas in DC were dredged from Yankee Rd Sta 0+00 to 58+100. The 1984 project removed 22,180 cubic yards of dredge spoils to nearby locations. MCD records on the 1984 dredging indicate that show dredge spoils being placed in 6 disposal areas (listed below) near residential and/or floodplain areas. We have 10 Daily Construction Reports (DCRs) that give us some information as to the disposition of dredge material in 1984. Note that in the first Daily Construction Report (**DCR1**) dated 7/25/84 on the "Location of Spoil Area" entry states the following: *"Kelchner has contacted several landowners along Oxford State Road about placing spoil on slopes and high portions of properties along Oxford State. He hopes to spoil most of the material with pans and use the haul roads as little as possible."*

Reggie Arkell's interview/memo with [redacted] supports the above as he indicated that "*the material taken from Dicks Creek was moved by some type of equipment with a scrapper that transported and/or dragged the fill before spreading it onto his property. He did not recall it being loaded into dump trucks of any kind.*" Also, the 11/16/04 interview/memo with MCD's Rinehart states that "*project work in 1984 was focused on excavating the material from the banks of the waterway....the majority of material removed was deposited in areas farther away from the creek....some type of equipment with a scrapper was used to remove most of the material.*" MCD's Rinehart also identified the [redacted] property as dredge material disposal site. <u>See Figure 2 and green property in the Rinehart memo. As part of CA, I think the whole [redacted]ot needs to be sampled for PCBs.</u>

Tom [redacted] also indicated that the Glenn Cartage Company property received Dicks Creek material. <u>See Figure 2 and the violet property in the Rinehart memo.</u> Arcadis Figure 2 provided by AK shows the two meanders between Yankee Rd and the NY RR bridge. Dicks Creek dredge material from the larger north-side meander was probably spread onto this property in the same way as the nearby [redacted] property. Arcadis Figure 2 shows 15 floodplain sampling locations between Yankee Rd and the NYRR bridge, including the proposed deep sampling location at the top of the north-side meander. The northside meander may actually be part of the Glenn Cartage Company property. <u>As part of CA, I think the entire Glenn Cartage property needs to be sampled for PCBs. I am concerned about the several properties located between the [redacted] and Glenn Cartage properties. The Acardis Figure 2 ariel photo-map is dated 2004 and appears to show trees and open areas with no buildings. Unless this area is a high spot, you would think that fill material would have been spread across this area also. Under CA, some additional sampling should be done in the back-half of these properties.</u>

The remaining DCRs, with dates, Limits of Earthwork, Location of Spoil Area and Construction Activity entry information and disposal amounts are listed below. Note that the right bank is the north-side of Dicks Creek and left bank is the south-side if Dicks Creek. See MCC 9/1/04 revised Contract Map 142)

DCR2 dated 8/6/84 Right bank Sta 14+00 to Sta 18+00 (area midway between RR bridge and Old channel Spoil Area) Location of Spoil Area entry states "Equipment parked at Oxford State Road with rear of lot used as disposal site."

DCR3 dated 8/14/84 Right bank Sta 32+00 to Sta 36+00 (near/upstream of Outfall 002) Location of Spoil Area entry states "Equipment parked at Oxford State Road with rear of lot used as disposal site." Construction Activities entry states that "widend road on Levey & put 4 ' fill over Standard Oil & C.G.& E Lines..Removed one tree on Levey Station 36 +00" (Levey is probably levee.) The Standard Oil and C.G.&E pipelines mentioned above crosses Dicks Creek (DC) at the NY RR bridge and runs along Oxford State Rd. <u>Unclear where the 4 feet of fill would have been placed, but it could be at Sta 36 ,along Oxford State Rd. north of Outfall 002. See Arcadis Figure 4 map/photo.</u>

DCR4 dated 8/15/84 Right bank Sta 36+00 to Sta 39+46 (near/upstream of Outfall 002) Location of Spoil Area entry states "Equipment parked at Oxford State Road with rear of lot used as disposal site." Construction Activities entry states "10:00 to 3:30 Loaded trucks for Armco"

DCR5 dated 8/16/84 Right bank Sta 38 +00 to Sta 44 +00 (near/upstream of Outfall 002) Location of Spoil Area entry states "Equipment parked at Oxford State Road with rear of lot used as disposal site." Construction Activities entry states "Loading and hauling dirt between Sta 38+00 -41+64.23 Loading Trucks for Armco & 2 Euclid Pans hauling in Burridge Machine Shop Lot...Kelchner started disposal area in lot behind Burridge Machine Shop.

DCR6a dated 8/21/84 Right Bank Sta 56+00 to Sta 58+00 (near/upstream of slag haul road) Location of Spoil Area entry states "Equipment parked at Burridge Machine on Oxford State Road, rear lot used as disposal area".

I think the disposal area for DCRs 3 thru 6a is the rear lot of the old Burridge Machine Shop property and/or the old Armco lot located north/above the Old Channel Spoil areas and south of Oxford State Rd.. See Figure 2 and yellow property in the Rinehart memo. CA sampling should focus of the rear half of the old Burridge Machine Shop property but some samples should be taken in the front portions as the fill dirt may have moved around over the years. CA sampling should also sample the old Armco lot located north/above the Old Channel Spoil areas and south of Oxford State Rd..

DCR6b dated 8/21/84 Left Bank Sta 4+00 to Sta 6+00 (near/upstream Yankee Rd bridge) Location of Spoil Area entry states "Disposal site Middletown Welding Co. Lot. Disposal for left bank material between Yankee & RR bridge". This is the Orman Welding property and is identified in Figure 2 as the pink property. Mike Mikulka says that a photo at Orman's shows the 1984 disturbed/regraded area adjacent to Dicks Creek. As I understand our current sampling agreements with AK, this areas should be addressed via our hot spot and floodplain sampling.

DCR7 dated 8/28/84 Left bank Sta 54+00 to Sta 58+00 (near/upstream of slag haul road) "Removing dirt at creek side and stock piling. Did not haul any today"

DCR8 date ?? Left Bank Sta 36+00 to Sta 38+00 and Sta 52+00 to Sta 54+00 Location of Spoil Area entry states "Disposal area on Armco lot left side of the stream." Construction Activities entry states "2 Euclid pans hauling dirt ...61 loads Armco lot... site visit A.M. Rinehart." This may be the AK Steel General Slag Dumping Area identified by Rinehart and shown in Figure 2. I think we have some floodplain samples on the south side of the creek near this area.?? They may have used the dredge material to cap the old slag landfill area so some CA sampling in the 0- 1' and 1-2' foot range may be warranted. Suggest we try and get 10 to 20 discretionary samples for this area.

DCR 9 dated 9/8/84 Left Bank Sta 24+00 to Sta 28 +00 (south-side opposite the big meander) Location of Spoil Area entry states "Disposal area Oxford State Rd and Ottawa St." Construction Activities entry states "Loaded and hauled 97 loads on 2 Euclid Pans." This area was not specifically identified in the [redacted] or Rinehart memos. It may be old Armco lot located north/above the Old Channel Spoil areas and south of Oxford State Rd. I could also be AK/Armco property located at the intersection of Oxford State Rd (northside) and Ottawa St. (westside) near the old Coke Oven Condensate Tanks. CA sampling should be done in this both areas.

DCR10 dated 9/13/84 Left bank Sta 18+00 to Sta 24 +00 (south-side opposite the big meander) Location of Spoil Area entry states "Disposal area on right bank at station 14+00 on private lot Cecil Osburn Oxford State Rd". This one is weird in that left/south bank material is being reported disposed of on the right/northside of Dicks Creek?? Sta 14 +00 and Oxford State Rd intersection would be one/two of the properties shown in Figure 2 that is about half between the Old Channel Spoil Area and the NY RR bridge?? Properties 8, 9, and/or 10 as shown in Figure 2. Arcardis Figure 3 photo-map dated 2004 shows area to have some trees but mostly open area

We need to remember that MCD memo dated 8/27/84 describes the proposed installation of 693 feet of "beach drains" mostly on the right bank or north side of Dick's Creek between Stations 8 to 45. The drains are described as 3 to 3.5 feet wide and 12 to 18 inches deep and fill with +4" slag even with the beach grade. It is unclear to me if these drains are perpendicular or parallel to Dicks Creek. Do we want to ask AK for more information on this?? Should they sample several of the beach drains as part of CA to see if they are a PCB problem??

Lastly, the MCD memo (page 2, item 4) also mentions a buried 30" metal culvert near 19+65 that has no outlet to the creek . This area is located in the "old channel spoil areas" on MCD Contract 142 Map. The culvert could have accumulated PCBs over the years and/or PCBs may have discharged to the creek via the culvert. I think we need to tell AK about this, before they begin any remediation of this area of Reach 1.

Based on the above, there are ten suspected areas there 1984 Dicks Creek dredge spoils were placed. Beginning at Yankee Rd Bridge and moving eastward the suspected areas are:

- Glenn Cartage property (violet on Figure 2) (north-side DC);
- Back-half of properties between Glenn Cartage and [redacted] properties (north-side DC);
- [redacted] property (green on Figure 2) (north-side DC);
- Middletown/Ormans Welding (pink of Figure 2) (south-side DC);
- Back-half of properties located between Sta 12 to Sta 18 (Osburn lot north-side DC);
- Old Armco lot/property north of big meander between Sta 19 to Sta 25 (north-side DC);
- AK/Armco property located at the intersection of Oxford State Rd (northside) and Ottawa St. (westside) near the old Coke Oven Condensate Tanks;
- Pipeline fill-Sta 36, along Oxford State Rd, north of Outfall 002. (northside DC);
- Burridge Machine Property (yellow on Figure 2) (northside DC); and
- AK Steel General Slag Dumping Area.

Areas of concern would be the beach drains between Sta 8 to Sta 45 and buried culvert at Sta 19+65.

Ex Kano Sams
<ExkanoS@lerachlaw .com
>

12/06/2004 12:10 PM

To Robert.Darnell@usdoj.gov

cc TBehlen@ag.state.oh.us, Michael Mikulka/R5/USEPA/US@EPA, jeff.hines@epa.state.oh.us, Michael Calhoun/DC/USEPA/US@EPA, Steven.Willey@usdoj.gov

bcc

Subject Comments on Sampling

Rob,

Here are Bruce's comments on sampling:

Pre-dredging characterization: While I agree with all of EPA's comments
on the sampling, whether they are necessary depends on two things. First, if the sampling is to guide the dredging with post dredging confirmatory sampling, then I believe AK should be left to decide if additional pre-sampling work is worth the cost (although I agree with EPA that it is likely to save money in the long run). If the sampling is to delineate contamination so that post dredging confirmatory sampling is not necessary, I believe that all of EPA's comments must be
implemented. My preference is for post dredging sampling.

Let me know if you have any comments. Thanks.

202-564-9001

To: Mike Calhoun MMEB

Michael Calhoun/DC/USEPA/US
12/06/2004 04:09 PM

To

Subject Dredging and Dredge Spoil Disposal Areas

Here is a draft of my homework. I will miss the call tomorrow but will be in on Wed. thx 202-564-6031

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DRAFT--------

Dredging and/or channelization has taken place in 1967, 1975, 1976 and 1984 from point 400 feet west/downstream of Yankee Rd bridge to upstream/east of Yankee Rd bridge to Sta 150+00 (intersection of North Branch of DC and main DC). (We know that Armco/AK had at least 57 PCB transformers in 1977. Many of these had probably been there for
20 to 30 years prior. Beginning in 1983, Armco/AK began disposing of PCBs transformers, which was completed around 1999. We do not know the first use date for PCBs hydraulic oil at the Middletown works. We do know that Armco purchased 990,000 pounds of Monsanto-brand hydraulic oil between 1970 and 1972. I believe PCB hydraulic oil use began in the mid 1950's, but I cannot prove it yet!!)

1967

The 1967 dredging/channelization between Sta 0+00 to Sta 50+00 straightened the creek by pushing the sediments onto the existing creek-banks and/or floodplain areas. This dredging also isolated two large meanders located at Sta 19+00---Sta 25+00 and Sta 38+00---Sta 48+00. An estimated 100,000 cubic yards of creek sediments east of Sta 50 to Sta 150 were also removed to onsite Armco fill areas (see MCC 9/1/04 revised Contract Map 142). As part of Corrective Action (CA), should we require AK to sample several of these fill areas to determine if PCBs are present? YES

1975 and 1976

The location and extent of dredging work done in 1975 and 1976 and dredge spoil disposal areas are unknown at this time.

1984

In 1984, several areas in DC were dredged from Yankee Rd Sta 0+00 to 58+100. The 1984 project removed 22,180 cubic yards of dredge spoils to nearby locations. MCD records on the 1984 dredging indicate that show dredge spoils being placed in 6 disposal areas (listed below) near residential and/or floodplain areas. We have 10 Daily Construction Reports (DCRs) that give us some information as to the disposition of dredge material in 1984. Note that in the first Daily Construction Report (DCR1) dated 7/25/84 on the "Location of Spoil Area" entry states the following:
"Kelchner has contacted several landowners along Oxford State Road about placing spoil on slopes and high portions of properties along Oxford State. He hopes to spoil most of the material with pans and use the haul roads as little as possible."

Reggie Arkell's interview/memo with [redacted] supports the above as he indicated that "the material taken from Dicks Creek was moved by some type of equipment with a scrapper that transported and/or dragged the fill before spreading it onto his property. He did not recall it being loaded into dump trucks of any kind." Also, the 11/16/04 interview/memo with MCD's Rinehart states that "project work in 1984 was focused on excavating the material from the banks of the waterway....the majority of material removed was deposited in areas farther away from the creek....some type of equipment with a scrapper was used to remove most of the material." MCD's Rinehart also identified the [redacted] property as dredge material disposal site. See Figure 2 and green property in the Rinehart memo. As part of CA, I think the whole lot needs to be sampled for PCBs.

OK IF HE LETS AK DO IT. → IS IT AK PROBLEM OR MCD/HIS PROBLEM?

The remaining DCRs, with dates, Limits of Earthwork, Location of Spoil Area and Construction Activity entry information and disposal amounts are listed below. Note that the right bank is the north-side of Dicks Creek and left bank is the south-side if Dicks Creek. See MCC 9/1/04 revised Contract Map 142)

DCR2 dated 8/6/84 Right bank Sta 14+00 to Sta 18+00 (area midway between RR bridge and Old channel Spoil Area)
Location of Spoil Area entry states "Equipment parked at Oxford State Road with rear of lot used as disposal site." O/K → SHOULD TRY TO GET ACCESS TO SAMPLE THE AREA.

DCR3 dated 8/14/84 Right bank Sta 32+00 to Sta 36+00 VIC OF OUTFALL 002
Location of Spoil Area entry states "Equipment parked at Oxford State Road with rear of lot used as disposal site."
LEVEY = LEVEE
Construction Activities entry states that "widend road on Levey & put 4 ' fill over Standard Oil & C.G.& E Lines..Removed one tree on Levey Station 36 +00" (I could not locate Levey Street. The Standard Oil and C.G.&E pipelines mentioned above cross Dicks Creek (DC) at the NY RR bridge and run along Oxford State Rd. Unclear where the 4 feet of fill would have been placed?) ON LEVEE ADJACENT TO DC.

DCR4 dated 8/15/84 Right bank Sta 36+00 to Sta 39+46 UPSTREAM OF OUTFALL 002
Location of Spoil Area entry states "Equipment parked at Oxford State Road with rear of lot used as disposal site."
Construction Activities entry states "10:00 to 3:30 Loaded trucks for Armco"

DCR5 dated 8/16/84 Right bank Sta 38 +00 to Sta 44 +00 UPSTREAM OF OUTFALL 002
Location of Spoil Area entry states "Equipment parked at Oxford State Road with rear of lot used as disposal site."
Construction Activities entry states "Loading and hauling dirt between Sta 38+00 -41+64.23 Loading Trucks for Armco & 2 Euclid Pans hauling in Burridge Machine Shop Lot...Kelchner started disposal area in lot behind Burridge Machine Shop. → MAY NOT HAVE A LOT OF PCBS. TRY TO SAMPLE BURRIDGE MS (NEW - SCHUMAN).

UPSTREAM OF SLAG HAUL ROAD.
DCR6a dated 8/21/84 Right Bank Sta 56+00 to Sta 58+00
Location of Spoil Area entry states "Equipment parked at Burridge Machine on Oxford State Road, rear lot used as disposal area" . I think the disposal area for DCRs 3 thru 6a is the rear lot of the old Burridge Machine Shop property. See Figure 2 and yellow property in the Rinehart memo. CA sampling should focus of the rear half of the lot but some samples should be taken in the front portions as the fill dirt may have moved around over the years. UPSTREAM OF PCB SOURCE AREAS. VERIFY W/ SAMPLING IN CASE OU3 OLD SOURCE.

DCR6b dated 8/21/84 Left Bank Sta 4+00 to Sta 6+00
Location of Spoil Area entry states "Disposal site Middletown Welding Co. Lot. Disposal for left bank material between Yankee & RR bridge". This is the Orman Welding property and is identified in Figure 2 as the pink property. Mike Mikulka says that a photo at Orman's shows the 1984 disturbed/regraded area adjacent to Dicks Creek. As I understand our current sampling agreements with AK, this areas should be addressed via our hot spot and floodplain sampling. Do you agree?? YES.

DCR7 dated 8/28/84 Left bank Sta 54+00 to Sta 58+00 UPSTM OF PCB SOURCE AREA.
"Removing dirt at creek side and stock piling. Did not haul any today"

WITHIN PCB SOURCE AREA
DCR8 date ?? Left Bank Sta 36+00 to Sta 38+00 and Sta 52+00 to Sta 54+00 → UPSTM OF SLAG HAUL RD.
Location of Spoil Area entry states "Disposal area on Armco lot left side of the stream." Construction Activities entry states "2 Euclid pans hauling dirt ...61 loads Armco lot... site visit A.M. Rinehart." This may be the AK Steel General Slag Dumping Area identified by Rinehart and shown in Figure 2. I think we have some floodplain samples on the south side of the creek near this area.?? They may have used the dredge material to cap the old slag landfill area so some CA sampling in the 0- 1' and 1-2' foot range may be warranted.

DCR 9 dated 9/8/84 Left Bank Sta 24+00 to Sta 28 +00
Location of Spoil Area entry states "Disposal area Oxford State Rd and Ottawa St." Construction

Activities entry states "Loaded and hauled 97 loads on 2 Euclid Pans." This area was not identified in the [redacted] or Rinehart memos. I may be old Armco lot located north/above the Old Channel Spoil areas and south of Oxford State Rd. I could also be AK/Armco property located at the intersection of Oxford State Rd (northside) and Ottawa St. (westside) near the old Coke Oven Condensate Tanks. YES, NEED TO SAMPLE BOTH LOTS, ONE no longer owned by AK. (Same as Oxford)-

DCR10 dated 9/13/84 Left bank Sta 18+00 to Sta 24 +00
Location of Spoil Area entry states "Disposal area on right bank at station 14+00 on private lot [redacted] Oxford State Rd". This one is wierd in that left/south bank material is being reported disposed of on the right/northside of Dicks Creek?? Sta 14 +00 and Oxford State Rd intersection would be one/two of the properties shown in Figure 2 that is about half between the [redacted]? Properties 8, 9. and/or 10 as shown in Figure 2. (NOT LISTED AS OSBURN)

We need to remember that MCD memo dated 8/27/84 describes the proposed installation of 693 feet of "beach drains" mostly on the right bank or north side of Dick's Creek between Stations 8 to 45. The drains are described as 3 to 3.5 feet wide and 12 to 18 inches deep and fill with +4" slag even with the beach grade. It is unclear to me if these drains are perpendicular or parallel to Dicks Creek. Lastly the MCD memo (page 2, item 4) also mentions a buried 30" metal culvert near 19+65 that has no outlet to the creek . This area is located in the "oil channel spoil areas" on MCD Contract 142 Map that I think may have high PCBs. The culvert could have accumulated PCBs over the years and/or PCBs may have discharged to the creek via the culvert.

Michael Calhoun/DC/USEPA/US
11/23/2004 01:38 PM

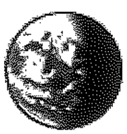
To

Subject Fw: Sampling Comments.doc

PRIVILEGED AND CONFIDENTIAL
ATTORNEY-CLIENT PRIVILEGED
ATTORNEY WORK PRODUCT

This was sent to Sierra Club and OH. Have they commented on it ?? Seems reasonable to me. Has anything change on this?? I think that at least 3 locations should be cored across the Creek to more accurately quantify the "depth of contamination" at each cross-section. Maybe you can rephrase it to say the "depth of sediment and the transition into the native/clean substrate layer"?? We want to make sure they go down deep enough?? Since they are going to divert the water in the remedial segment, they can scrapped off the top 6 inches in the shallow creek side areas anyway. The three cores across the creek could be put in the places (more towards the middle or in depostional areas) where there is at least 6 inches of sediment. Lastly, perfection is the enemy of the good in Reach 1 and MD!! I think we take a gross source sediment removal and run with it!!

----- Forwarded by Michael Calhoun/DC/USEPA/US on 11/23/04 02:01 PM -----



"Darnell, Robert (ENRD)" <RDarnell@enrd .usdoj.gov>
11/12/04 04:11 PM

To "'ExkanoS@lcsr.com'" <ExkanoS@lcsr.com>, "'TBehlen@ag.state.oh.us'" <TBehlen@ag.state.oh.us>

cc Michael Mikulka/R5/USEPA/US@EPA, "Willey, Steven (ENRD)" <SWilley@enrd.usdoj.gov>, Michael Calhoun/DC/USEPA/US@EPA, Peter Moore/DC/USEPA/US@EPA

Subject Sampling Comments.doc

Attached are draft comments on AK's proposal for sampling to establish the verticle extent of dredging in Reach 1 and MD. Perhaps we can discuss in conjunction with the biomonitoring issues call (the subject of a separate email I just sent). Please let me know. Thanks. Rob

Draft
Joint prosecution priviledged
Attorney work product
Prepared for settlement purposes only; not admissible as evidence pursuant to FR 408

To: Rob Darnell, Trial Attorney
U.S. Department of Justice

One of the outstanding issues from the October 13, 2004, settlement meeting was the government's response to AK's proposal dated August 11, 2004, for sampling to establish the vertical extent of dredging in Reach 1 of Dicks Creek, including Monroe Ditch.

Background

Sediment removal has been proposed for the portion of Dick's Creek extending from about 50 feet upstream of Outfall 002 to about 50 feet downstream of the USGS Gauging Station near Yankee Road. Monroe Ditch as far upstream as the second culvert will also be dredged. The purpose of the sampling proposed by AK is to determine the vertical extent of dredging. The specific objective is to verify whether the confining clay layer underlying Dicks Creek and Monroe Ditch serves as a boundary below which PCBs do not occur at significant (i.e. greater than 1 ppm) levels.

Study Design Proposed by AK

Sediment core samples will be collected from depositional zones within Dick's Creek at approximately 200 foot intervals (approximately 15 locations). Three samples will be collected from the lower reach of Monroe Ditch, including one sample at the confluence with Dick's Creek and two samples upstream of this point. Each sediment core sample will extend up to two feet into the confining clay layer.

Several sediment samples will be collected within or below the clay layer in each core. For example, samples might be collected from 2 to 6, 6 to 10, 10 to 14 and 14 to 18 inches below the top of the clay layer. The uppermost sample would be analyzed for PCBs, and the remaining samples would be held pending the results of the initial analysis. If PCBs are present above the established cleanup level, additional samples will be analyzed to determine the vertical extent of dredging. The selected samples will be analyzed for PCBs using pressurized fluid extraction and USEPA Method 680 (PCB homologues).

USEPA Comments on Study Design

USEPA is of the understanding that all contaminated sediment within Reach 1 will be excavated and removed. The purpose of the pre-remedial sampling is to verify the extent of removal at cross-sections of Dicks Creek and Monroe Ditch in order to better scope the project. Dicks Creek varies in width in Reach 1 but is generally on the order of 50 - 60 feet in width. The MCD project identified a design channel width at 60 feet. The question we have is whether one core per cross-section is sufficient to answer the design question of how deep to excavate and whether or not the depth is constant across the stream width. Our position is that it is better to do additional sampling at the design stage in order to scope the construction project as accurately as possible. This should save money in the long term. AK's position is that the sediment is homogenous across the stream width. This is thought to be unlikely based on past sampling. As such, the design of the sampling program should verify whether or not this is the case. Initially, 2-3 cores across the width should be taken and tied to a vertical and horizontal datum such that the depth of excavation can be adequately determined. The second question is what should be the distance between cross sections. USEPA initially envisioned a distance between cross sections of 50 feet. Certainly in the vicinity of transition structures such as the RR bridge downstream of Monroe Ditch, this should not be exceeded. Where there is no transition, perhaps increasing the distance to 100 feet would be appropriate.

Sampling Methods Proposed by AK

Sediment cores will be collected using a vibracoring device. First, an 8-inch diameter section of pipe or other casing material will be advanced into the sediment approximately 6 inches below the sediment surface and dewatered to create a dry work area. Next, a 2-inch wide stainless steel core sampler, with a butyrate core liner, will be advanced up to 6 feet below the sediment surface using a direct current (DC) vibratory head in conjunction with a slide hammer. The core sampler will be extracted from the sediment by hand in conjunction with the slide hammer to lessen the chance for disturbing sample integrity. A basket-type core catcher will be used to retain the sediment core within the butyrate core liner. The liner will be extruded from the sampler, capped, and labeled (top and bottom).

Sediment samples will be collected from downstream to upstream, and sampling locations will be recorded with a global positioning system (GPS) unit. Sample identification codes will be assigned consecutively and will indicate the water body sampled, the medium, the location number, and the sample depth (e.g., DC-CLAY-01-2-8). Sampling logs and field notes will be recorded, according to methods previously established for the site. Sampling logs will include the depth from the sediment surface to the confining clay layer. Sample containers will be appropriately packed, labeled, and placed in coolers with bagged ice for shipping to the analytical laboratory.

Procedures such as decontamination of equipment, data validation, and health and safety measures will be conducted in accordance with the Quality Assurance Project Plan (QAPP) and Health and Safety Plan (HASP) for the site. Disposable equipment will be used where possible to minimize the potential for cross-contamination. One equipment blank will be collected each day for any equipment requiring decontamination. Field duplicate samples will be collected at a rate of 1 per 10 samples, and matrix spike/matrix spike duplicate (MS/MSD) samples will be collected at a rate of 1 per 20 samples. Unused sediment and decontamination fluids will be collected for proper off-site disposal.

USEPA Comments on Sampling Methods Proposed by AK

USEPA agrees with collection via vibracore and the other procedures specified. Prior to collection, a vertical elevation of the top of the sediment at each sample location should be determined with respect to a benchmark on shore. This will allow a more accurate estimate of the total volume of sediment to be excavated. Further, at least 2 and preferably 3 locations should be cored across the Creek to more accurately quantify the depth of contamination at each cross-section.

From: "Darnell,Robert (ENRD)" <RDarnell@enrd.usdoj.gov>
To: Robert Guenther/R5/USEPA/US@EPA, Michael Calhoun/DC/USEPA/US@EPA, Peter Moore/DC/USEPA/US@EPA, GARY CYGAN/R5/USEPA/US@EPA, Michael Mikulka/R5/USEPA/US@EPA
cc: "Willey,Steven (ENRD)" <SWilley@enrd.usdoj.gov>

Date: Wednesday, November 17, 2004 09:00AM
Subject: FW: Meeting on Friday

-----Original Message-----
From: b.bell@cea-enviro.com [mailto:b.bell@cea-enviro.com]
Sent: Wednesday, November 17, 2004 11:39 AM
To: ExkanoS@lerachlaw.com; Non-responsive [redacted] marilyn.wall@env-comm.org; daltman@environlaw.com; susan.knight@sierraclub.org

Cc: Darnell, Robert (ENRD)
Subject: RE: Meeting on Friday

Ex Kano - My thoughts on the various issues:

In-situ remediation. I remain strongly opposed to the idea of in-situ remediation. There are several reasons for this:

* It's unproven technology. There has been mostly lab work and I believe some pilot scale field work. None of it has been done for a long enough period to ensure long term results.
* Given the flashly nature of Dicks Creek and the estimates made of scour velocity, it seems a sure thing that significant downstream transport of the sediment, activated carbon and PCBs must occur. This will make monitoring of any in-situ remediation extremely difficult because you will wind up chasing the remediation downstream.
* Activated carbon will be abraded to smaller and smaller size due to scour and abrasion in the sediment during high flow velocities. The activated carbon is likely to be ground down to very small size and become resuspended in the water column. This does two things. First, the PCBs will be moved out of the monitoring zone. Second, at some size, the activated carbon and its associated PCB load will become available for ingestion and even move through gills. I have no idea how biologically available PCB will become at that point.
* Definition of success should be sufficiently reduced reduction in fish

(if you can find where to monitor after the sediment moves) to lift all restrictions.
* I see nothing in the habitat and access that would prevent restoration of the habitat in short order as long as access for dredging and support is carefully done.

Biological Monitoring: Having said that I oppose the in-situ work for the reasons above, I agree with EPA's comments on the biomonitoring. Monitoring of benthic organisms must be included.

Pre-dredging characterization: While I agree with all of EPA's comments on the sampling, whether they are necessary depends on two things. First, if the sampling is to guide the dredging with post dredging confirmatory sampling, then I believe AK should be left to decide if additional pre-sampling work is worth the cost (although I agree with EPA that it is likely to save money in the long run). If the sampling is to delineate contamination so that post dredging confirmatory sampling is not necessary, I believe that all of EPA's comments must be implemented. My preference is for post dredging sampling.

Please let me know if you have any questions. Thanks.

Bruce

-----Original Message-----
From: Ex Kano Sams [mailto:ExkanoS@lerachlaw.com]
Sent: Tuesday, November 16, 2004 6:50 PM
Non-responsive [redacted] Bruce A. Bell; marilyn.wall@env-comm.org; daltman@environlaw.com; susan.knight@sierraclub.org
Cc: robert.darnell@usdoj.gov
Subject: RE: Meeting on Friday

Bruce, please include Rob in any thoughts you have about EPA's comments on in-situ. Thanks.

>>> "Bruce A. Bell" <b.bell@cea-enviro.com> 11/16/2004 11:15:36 AM >>>
If you guys need to call me, I should be available.

Bruce

-----Original Message-----
From: Ex Kano Sams [mailto:ExkanoS@lerachlaw.com]
Sent: Tuesday, November 16, 2004 12:17 PM
To: m.kavanaugh@att.net; Bruce A. Bell; marilyn.wall@env-comm.org;

daltman@environlaw.com; susan.knight@sierraclub.org
Subject: Meeting on Friday

The meeting on Friday will be at 8:30 (for the premeeting) with a meeting with AK Steel to follow. It will be in the Ohio AG's office.

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From: Michael Calhoun/DC/USEPA/US
To: Michael Mikulka/R5/USEPA/US@EPA
cc: "Rojko,Cathy (ENRD)" <CRojko@enrd.usdoj.gov>, GARY CYGAN/R5/USEPA/US@EPA, James Morris/R5/USEPA/US@EPA, Peter Moore/DC/USEPA/US@EPA, Robert Guenther/R5/USEPA/US@EPA, "Willey,Steven (ENRD)" <SWilley@enrd.usdoj.gov>, "Biros,Frank (ENRD)" <FBiros@enrd.usdoj.gov>, "Darnell,Robert (ENRD)" <RDarnell@enrd.usdoj.gov>, "Page,Mitchell G. (ENRD)" <MPage@enrd.usdoj.gov>

Date: Tuesday, November 16, 2004 01:08PM
Subject:

PRIVILEGED AND CONFIDENTIAL
ATTORNEY-CLIENT PRIVILEGED
ATTORNEY WORK PRODUCT

DRAFT --Suggestions for your review.

Option A--100 Foot Transect in Reach 2 creek sediment characterization proposal
Reach 2 is 1.5 miles (times 5,280/mile)= 7,920 feet/100 ft transects==79 transects at 100' spacing
79 transects times 6 samples per transect (and 6" sample interval) == **474 total samples** if all samples had to be taken, which in some transects may not happen if the sediment is not to deep.
Spatial sample distribution within the creek could be any one of the following. (The 3/4 sample locations are in the deep depositional areas that may or may be in the middle of the creek.)

2
[1/2 3/4 5/6] or [1 3/4 6] or [1 2 3/4 5 6]
^ Creek A
5
^Creek C
(uniform bottom)
^Creek B
(wide channel)
(deep area)

We could specify that the samples on the far left and far right of center (numbers 1 and 6 above) must be in the littoral zone (shallow 6" shore/bank/riffle zone). This would always keep each location as a single sample and two samples total. If the creek is very wide a some locations (wide channel Creek C), we could further specify that the sample numbers 2 and 5 would each be a single sample each if the sediment depth is more the 6" but less than 12". For example, if the depth is 10", they collect a 10" sample and test it for PCBs.

Option B--**250 Foot Transect in Reach 2 creek sediment characterization proposal**
Reach 2 is 1.5 miles (times 5,280/mile)= 7,920 feet/250 ft transects==32 transects at 250' spacing
32 transects times 6 samples per transect (and 6" sample interval) == **192 total samples**if all samples had to be taken, which in some transects may not happen if the sediment is not to deep. In this scenario,
the transcects may not be plotted in an equidistance manner but biased to deep/depostional and/or location to populated areas. Even if we do this, we will probably need around 50-75 samples additional discretionary samples based on a onsite field survey to supplement sampling in some areas. We may decide to add more transects in certain areas, or more samples to existing transects, or other areas not known at this time. The base number (192) and the max discretionary number (75) gets you to **267 total samples**.

Sent 12/10/04
to DOJ & HQ

Attorney-Client Privilege
Prepared for Settlement Purposes Only

Issue **Pre-Remedial Sampling in Reach 2**

A potential issue from the November 19, 2004, settlement meeting was raised by AK's response to the government position on dredging vs. in-situ in Reach 2. AK seemed to imply that if they agreed to proceed with dredging of Reach 2, no pre-dredging sampling was needed, and that they would simply remove all material in Reach 2, based on their prior Reach 2 survey work.. This may be related to the cost of sampling, which AK has estimated at $350-400 per sample for analytical.

Background

Sediment removal (via hydraulic dredging) has been proposed by the plaintiff's for the portion of Dick's Creek extending from about 50 feet downstream of the USGS Gauging Station near Yankee Road, to just downstream of Main Street. AK has proposed an in-situ carbon addition project, with subsequent biological monitoring. We anticipate that AK may agree to the government's proposal at the December 17, 2004, meeting.

AK has done sediment probings throughout both Reaches 1 and 2, as well as Monroe Ditch, to determine the volume of sediment to be removed. This probing was done with a metal rod, on transects spaced every hundred feet, at three points within each transect. AK has estimated the maximum sediment volume to be removed within Reach 2 of Dicks Creek at about 8600 cubic yards. USEPA has estimated the cost of hydraulic dredging at about $100 per cubic yard (Hayes 2004), so the cost would be on the order of $860,000 if all sediment were removed ($1,075,000 if increased by 25% for restoration in riffle areas).

Discussion

USEPA had anticipated that a pre-remedial sampling survey would be conducted by AK, to ascertain if the sediment in Reach 2 was contaminated over proposed clean-up levels (1 ppm) throughout, or whether contaminants were isolated in depositional hot spots. If isolated, the cost of remedial dredging could be reduced by limiting the scope of the dredging project to only those areas of Reach 2 where contamination is shown to exist. AK's statement raises the issue of whether the plaintiff's should forego a pre-remedial survey and rely solely on post-remedial confirmatory sampling.

The first issue seems to be whether the probing work can be relied upon to accurately determine the scope of the project. We know little about the methodology used by AK to conduct the probing work, and whether or not AK also conducted some visual verification work by pulling hand cores in conjunction with the probing. Without some verification, it seems questionable to rely upon the probings alone.

As Option 1, it therefore seems necessary for AK to take cores at all of the transects correlated to the probings, to verify that the probings accurately reflect the target sediment depths. If the probings are confirmed to be accurate by the cores, then we may be in a position to agree to have AK proceed to remediation without further sampling, provided an extensive post-remediation confirmatory sampling program were conducted. This would save AK the cost of the pre-remedial sampling, but may create uncertainty of success if post-remediation sampling shows PCBs above 1 ppm.

Another Option (Option 2) would be to have AK core a percentage of transects to verify the probings and then sample the cores to ascertain if the sediment is contaminated throughout the core, and to what depth. AK's probings estimated that only 29 of the transects in Reach 2 had sediments 1 foot or more in depth. At a minimum, each of these 29 transects should be cored and sampled, with sample depths targeted at 0-6", 6-12", 12-24', etc. At each transect, at least 2 cores should be taken to verify the condition across the stream width. (The second core should be sampled at a minimum at the surface interval, if the sediment depth is not consistent across the width, e.g. inside vs. outside bend of meander.) If each transect had 4 samples, that would be 116 samples. Additionally, some percentage of transects where the sediment is less than 1 foot (say 10 to 25%) should be sampled, to ascertain if this type of area is contaminated. This can be done based on a grid of the areas not included in the 29 transects above. This will allow us to gather pre-remedial information on areas likely to contain PCBs and some limited info on the remainder of Reach 2. Also, a post-remediation confirmatory sampling program would need to be conducted, but not as extensive as Option 1. The downsides of allowing this option are as follows: (1) the limited corings do not confirm the probings resulting in an uncertain remedial project; (2) the sampling misses one or more PCB hotspots at depths greater than the probings, meaning they are left in place after remediation; (3) the confirmatory sampling program finds PCBs over 1 ppm.

300-350 Samples

Option 3 would be to have AK conduct a detailed Pre-remedial design survey to identify both the target depths via coring, and delineate the PCB contamination by sampling each core. This would require the most expense prior to remediation, but would ensure the best scope for the remedial project, and hence the most certainty for AK with respect to project success. Under this scenario, a more limited confirmatory sampling program would be required.

RIFFLE AREAS → IF CAN'T USE CORE, TAKE EKMAN DREDGE OR PONAR [illegible],